# Annual Report


## WESTERN SHEEP BREEDING LABORATORY

AND

## UNITED STATES SHEEP EXPERIMENT STATION

DUBOIS, IDAHO

JUNE 30, 1943

This report of research projects not yet completed is intended for the use of administrative leaders and workers in this or related fields of research, and not for general distribution.

ANNUAL REPORT OF THE
WESTERN SHEEP BREEDING LABORATORY
FOR 1943 PAGES 1-34

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ANNUAL REPORT OF THE
U. S. SHEEP EXPERIMENT STATION
FOR 1943 PAGES 35-53

Major improvements in sheep are not effected in a short time. There are some very good reasons for this situation. Sheep reproduce rather slowly when compared with some of our other domestic animals. The first lambs in the Special Research Program were born in the spring of 1938. The second generation of sheep is now in production in the Laboratory program.

Moreover, the basic design of the improvement procedure does not afford a great deal of opportunity for major short-time advances in fundamental progress. Furthermore, the flocks involved are, in general, of relatively high productive capacity, under which condition measurable improvement with any system of breeding would move slowly. Probably incidental, but yet of some concern, is also the matter of seasonal environmental changes which, under conditions at this Laboratory, may not make it possible for heritable advances in potential metobolic activities to be freely expressed, particularly in the year in which they may occur, which, then, during the lifetime of the animal would tend to obscure the actual heritable gains.

Advances in specific characteristics that contribute to usefulness seem apparent and these are discussed in this report. The animal score summaries for these characteristics are also reported to show trend changes if and when they occur.

Techniques have been examined, and some have been changed to meet new problems. New techniques have also been tested and adapted to the program. These are discussed in full in the report.

A considerable portion of the report involves progress with no intention of drawing premature conclusions. Unless otherwise stated the summaries are preliminary and subject to change as the data increase.

ANNUAL REPORT
Western Sheep Breeding Laboratory
June 30, 1943

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# DIRECTORS OF STATE AGRICULTURAL EXPERIMENT STATIONS OF THE TWELVE WESTERN STATES THAT ARE COLLABORATING WITH THE WESTERN SHEEP BREEDING LABORATORY

| | |
|---|---|
| ARIZONA: | P. F. Burgess, University of Arizona, Tucson. |
| CALIFORNIA: | C. B. Hutchison, University of California, Berkeley. |
| COLORADO: | H. J. Henney, Colorado State Agricultural College, Fort Collins. |
| IDAHO: | E. J. Iddings, University of Idaho, Moscow. |
| MONTANA: | Clyde McKee, Montana State College, Bozeman. |
| NEVADA: | S. B. Doten, University of Nevada, Reno. |
| NEW MEXICO: | Fabian Garcia, New Mexico State College of Agriculture, State College. |
| OREGON: | W. A. Schoenfeld, Oregon State College, Corvallis. |
| TEXAS: | A. B. Conner, Agricultural and Mechanical College of Texas, College Station. |
| UTAH: | R. H. Walker, Utah State Agricultural College, Logan. |
| WASHINGTON: | E. C. Johnson, Washington State College, Pullman. |
| WYOMING: | J. A. Hill, University of Wyoming, Laramie. |

## COLLABORATORS OF THE WESTERN SHEEP BREEDING LABORATORY

| | |
|---|---|
| ARIZONA: | Ernest B. Stanley, Head, Department of Animal Husbandry, College of Agriculture, University of Arizona, Tucson. |
| CALIFORNIA: | James F. Wilson, Division of Animal Industry, College of Agriculture, University of California, Davis. |
| COLORADO: | A. Lamar Esplin, Department of Animal Husbandry, Colorado State College of Agriculture and Mechanics Arts, Fort Collins. |
| IDAHO: | C. W. Hickman, Head, Department of Animal Husbandry, College of Agriculture, University of Idaho, Moscow. |
| MONTANA: | Richard T. Clark, Head, Department of Animal Husbandry, Montana State College, Bozeman. |
| NEVADA: | Charles E. Fleming, Department of Range Management, College of Agriculture, University of Nevada, Reno. |
| NEW MEXICO: | Philip E. Neale, Department of Animal Husbandry, New Mexico College of Agriculture and Mechanics Arts, State College. |
| OREGON: | Ray G. Johnson, Department of Animal Husbandry, Oregon State Agricultural College, Corvallis. |
| TEXAS: | Bruce L. Warwick, Department of Animal Industry, Texas Agricultural and Mechanical College, College Station. |
| UTAH: | Frederick F McKenzie, Head, Department of Animal Husbandry, Utah State Agricultural College, Logan. |
| WASHINGTON: | M. E. Ensminger, Head, Department of Animal Husbandry, State College of Washington, Pullman. |
| WYOMING: | Fred S. Hultz, Head, Department of Animal Production, College of Agriculture, University of Wyoming, Laramie. |

ROSTER OF PERSONNEL

WESTERN SHEEP BREEDING LABORATORY AND U. S. SHEEP EXPERIMENT STATION,
Dubois, Idaho, as of June 30, 1943

| Name | Rating | Date entered on duty | General Duties |
|---|---|---|---|
| Nordby, Julius E., | Principal Animal Husbandman, P-6 | Mar. 1, 1938 | Director |
| Terrill, Dr. Clair E., | Animal Husbandman, P-4 | July 3, 1936 | Geneticist, physiologist |
| Stoehr, John A., | Assoc. Animal Husbandman, P-3 | Aug. 28, 1928 | Operations |
| Pohle, Elroy M., | Assoc.Animal Fiber Technologist,P-3 | May 2, 1938 | Wool Technologist |
| Hazel, Dr. Lanoy N., | Ass't. Animal Husbandman, P-2 | Sept. 1, 1942 | Statistician |
| *Sidwell, George M., | Jr. Animal Husbandman, P-1 | July 1, 1941 | Assistant, Physiology and genetics |
| *Emik, Dr. L. Otis, | Jr. Animal Husbandman, P-1 | July 7, 1941 | Assistant, Physiology and genetics |
| Keller, Henry R., | Jr. Animal Husbandman, P-1 | Oct. 16, 1941 | Assistant, wool laboratory |
| *Schaefer, Chester F., | Assistant Clerk, CAF-3 | June 22, 1936 | Clerk |
| **Harrison, Raymond H., | Assistant Clerk CAF-3 | Oct. 25, 1937 | Clerk |
| Keller, Edith C., | Assistant Clerk CAF-3 | Jan. 1, 1943 | Secretary |
| Jeffery, Lee C., | Foreman of Farm Laborers, CPC-5 | June 7, 1924 | General maintenance pumps, equipment |
| Rasmussen, Henry, Jr., | Farm Laborer,CPC-3 | July 1, 1926 | Farm Laborer |
| Hohman, Max E., | Farm Laborer,CPC-3 | Apr. 1, 1935 | Shepherd |
| Landacre, Harold E., | Farm Laborer,CPC-3 | Apr. 6, 1939 | Truck driver, general maintenance |
| Goldman, James R., | Farm Laborer,CPC-3 | May 1, 1939 | Shepherd |
| Smajla, Ivan | Farm Laborer,CPC-3 | Apr. 21, 1942 | Shepherd |
| Barger, Frank S., | Farm Laborer,CPC-3 | Apr. 16, 1943 | Shepherd |
| Phillips, Walter H., | Jr. Farm Laborer, CPC-2 | Mar. 16, 1935 | Truck driver |
| Powell, Fred A., | Jr. Farm Laborer, CPC-2 | May 11, 1935 | Teamster |
| Hoopes, Wendell L., | Jr. Farm Laborer, CPC-2 | Apr. 16, 1941 | Farm Laborer |
| Rawson, Thomas A., | Jr. Farm Laborer, CPC-2 | Mar. 23, 1942 | Shepherd |
| Nantz, Mrs. Dorinda R., | Unskilled Laborer | June 16, 1941 | Janitress & cook |

* On military leave.

** Transferred to War Department, with reemployment benefits.

PHYSICAL PLANT

47,482 acres of spring-fall and summer range are now available for grazing for the Station and Laboratory flocks. The four areas involved in this acreage are owned by the government. Summer grazing is available for about 1100 head on the Targhee National Forest, and winter grazing is available for about 2000 head on the Salmon National Forest. The physical plant comprises a central laboratory and office building, one experimental barn, lambing and shearing sheds, horse barn, machine shop, pump house, two deep well pumps, two reservoirs with a combined capacity of 120,000 gallons, 10 dwellings, 4 garages.

During the last fiscal year ending June 30, 1943, two adjacent acreages of approximately 640 acres each with water right facilities, and under fence, have been added in an area between the spring-fall range and the high altitude summer range and serve as an intermediate range between the early spring and summer range, thus facilitating continuity in succulent lamb feed throughout the spring and summer seasons.

OBJECTIVE OF THE WESTERN SHEEP BREEDING LABORATORY

The objective of this Laboratory is the improvement of range sheep that excel present sheep in adaptability, yield and quality of wool, and in lamb production.

In the pursuit of this objective, all of the sheep at this Laboratory are produced under range conditions, so the progress that is made is directly applicable to range practice. Moreover, the breeding program is so organized that any progress is substantially fundamental progress in germ plasm reorganization, hence is of a permanent nature.

Inbreeding is used in order to concentrate during the least possible time the desirable characters such as the most acceptable market form of lambs, and the production of an increased quantity as well as quality in wool. The characteristics in sheep that are of greatest value in range production are given the most emphasis in the breeding program.

SIGNIFICANCE OF PROBLEM

The range sheep industry of the twelve western states involves approximately 33,000,000 head of sheep producing annually in round figures in the neighborhood of 275,000,000 pounds of wool or somewhat more than two-thirds of the nation's supply. Approximately 65 percent of the nation's lamb tonnage also originates within this area. These estimates involve both fat and feeder lamb tonnage, but do not include the weight that is added to western feeder lambs in cornbelt feed lots. These sheep, western cattle and horses harvest the annual crop from approximately 394 million acres of public domain, state lands, National Forests and Indian reservations together with millions of acres of privately owned grazing land, and consume each year a vast tonnage of roughages, concentrates and farm by-products that are characteristic of western agriculture and essential to its success.

Sheep breeding on western ranges lacks stability with reference to definite ideas that should characterize wool type within areasand particularly within flocks. Admixture of breeding characterize a very large portion of the range flocks. Lack of uniformity in the breeding of the rams that are selected for use from year to year, and the inability to get an adequate supply of efficient rams, are, in large part responsible for this condition. The average mature ewe in the 12 western statesproduces only approximately 8½ pounds of unscoured wool. The average annual production of wool of the Laboratory Rambouillet flock that is maintained under average western range conditions is more than two pounds higher. This would indicate that there is room for improvement in the western fine-wool clip through attention to breeding.

This Laboratory, therefore, has some significant tasks ahead. Western ranges are adapted, in general, to the production of fine, half-blood, three-eights, and, in some areas, to quarter blood wool. These four grades are now being produced by the Rambouillet, Targhee, Columbia and Corriedale flocks of this Station all of which are being genetically purified through a carefully directed inbreeding program. This program is directed toward the production of not only maximum yield in wool and lamb, but for stability in wool type or quality to the end that they will reproduce with satisfactory economic efficiency the type of body and quality of wool which must characterize utility sheep. A very large percentage of the western range flocks produce wool within each flock that varies from fine to quarter blood. In general, the various grades are being marketed as a "bulk" lot without grading at the point of origin and consequently all grades of wool may be found in the same bag, thus making it impossible to appraise quality or shrinkage with any reasonable degree of accuracy, and consequently the wool market affords very little encouragement as a specialized market with reference to quality at the point of origin. While it is true that this Laboratory has for its objective the improvement of sheep through the application of breeding methods, it appears that this objective cannot possibly supply the ultimate answer unless all public institutions concerned with sheep and wool improvement in the west do their utmost in the best way they can to bring about a better understanding of quality to the end that the wool trade, primitive as it now is, will have to recognize a disciplined appreciation of values at the point of origin so the producer will be in a far more advantageous position than he is now to know values.

Grade Rambouillet sheep comprise the great bulk of the sheep in the range country of the west that produce fine wool. Their popularity is well understood since the bulk of all original bag wools originating in the west is fine wool. These grade Rambouillets are maintained in a very high heterozygous condition. This heterosis is desirable for commercial production in that it usually is associated with more vigorous lambs. The existing heterosis may come about by (1) using rams that are in themselves heterozygous, (2) by varying the source of rams from time to time or by both methods. The maximum effective heterosis, however, cannot be realized in this manner. But it has until recently been the only means available to the ranchman which would permit him to retain fine wool sheep. A number of the

breeders of purebred range and stud Rambouillet rams are doing some inbreeding in their flocks. However, they can likely not undertake a very intensive program of inbreeding because of its long time nature. But even slight inbreeding will prove of some value if it is pursued in a systematic manner. The heterozygosity which prevails explains in large part the variability in wool and body type that occur.

Any improved system of breeding must hold out immediate encouragement to the producer who can ill afford to jeopardise his income. He is concerned with increased quantity as well as quality in a uniform population with the minimum of variation. This is a big order. It is a challenge to any improved breeding method, and obviously it will be met only when the transmitting ability for these qualities becomes a genetic reality. It can become a genetic reality only through the persistent effort to purify the gene pattern by eliminating, through a systematic method of inbreeding, the recessive undesirables. Such a plan of breeding also brings about divergence, which, if and when it occurs, makes the individuals involved increasingly successful for outcrossing to produce maximum controlled heterosis.

Not all inbreeding efforts will likely be successful. The success of such efforts will, in general, be in proportion to the purity of the gene pattern for good genes when the venture is undertaken. But inasmuch as this breeding method is the only known practical solution to a gene purification program, some failures due to undesirable genotypes which cannot be detected in the foundation material will have to be expected.

Inbreeding is used at this Laboratory in order to concentrate during the least possible time the desirable characters such as the most acceptable market form of lambs, and the production of an increased quantity as well as quality in wool. The characteristics in sheep that are of greatest economic value in range production are given the most emphasis in the breeding program.

In the pursuit of the above objectives the following studies are involved and are recognized as research lines:

RESEARCH LINE PROJECTS

1. Development of systems of breeding for locating strains of Rambouillet sheep which may possess combinations of genes that will improve strains with which they may be crossed. This research line project includes:
   (a) The development of inbred strains or lines by the mating of animals as closely related as possible or desirable, and with emphasis on selection for all characters of economic importance.
   (b) The development of inbred lines with special reference to very important characters that are of economic importance to range sheep, such as mutton form, length of staple, and faces that are free from excess wool covering causing wool blindness.
2. Determination of the inheritance of various undesirable characteristics of Rambouillet sheep, such as defective jaws, abnormalities in the growth of wool, hairiness in fleeces of wool and excessive skin folds

or wrinkles, for the purpose of developing methods of breeding by which these undesirable characteristics may be eliminated from the stock.

3. Studies in the physiology of reproduction of Rambouillet sheep as they may contribute to the program of the Western Sheep Breeding Laboratory, including

(a) Sexual maturity of Rambouillet ram lambs,
(b) Quality of semen in relation to fertility, and
(c) Factors affecting fertility of ewes.

4. Studies in the physiology of wool production of Rambouillet sheep including reference to fiber uniformity within and between various regions of the fleece in relation to the total uniformity of the fleece.

5. Analysis of records of the characteristics of sheep and wool to determine the usefulness of such records in the program of the Western Sheep Breeding Laboratory.

## PUBLICATIONS FOR 1943

(Publications 1--23 from this Laboratory are listed in the 1942 annual report).

24. The importance of body weight in selection of range ewes, Clair E. Terrill and John A. Stoehr, Journal of Animal Science, Vol. 1, No. 3. August, 1942.

25. Relationship between weanling and yearling fleece characters in range sheep, Elroy M. Pohle, Journal of Animal Science, Vol. 1, No. 3, August, 1942.

26. Staple length in relation to wool production, Elroy M. Pohle and Henry R. Keller, Journal of Animal Science, Vol. 2, No. 1, February, 1943.

27. Improving Rambouillet Sheep for Western Ranges, Julius E. Nordby, National Wool Grower, Vol. 33, No. 3, March, 1943.

28. Length of staple of range wool and its influence on shrinkage and fleece values, Elroy M. Pohle and Henry R. Keller, National Wool Grower, Vol. 33, No. 6, June, 1943.

29. Stabilizing wool and body type in Whitefaced Crossbred Sheep for Western Range Production, Julius E. Nordby, to appear in National Wool Grower, Vol. 33, No's. 7 & 8, July and August, 1943.

30. Sampling and measuring methods for determining fineness and uniformity in wool, Elroy M. Pohle, L. N. Hazel and H. R. Keller, ready for publication.

31. Wool Fineness in eight sampling regions on yearling Rambouillet ewes, Elroy M. Pohle and R. G. Schott, to appear in Journal of Animal Science, 2(3): August, 1943.

32. Clean Wool yield variation among regions of Rambouillet fleeces, Elroy M. Pohle, H. W. Wolf and Clair E. Terrill, to appear in Journal of Animal Science, 2(3): August, 1943.

33. Fiber Density and some methods of its measurement in the fleece of Rambouillet sheep, H. W. Wolf, W. M. Dawson and E. M. Pohle, to appear in Journal of Animal Science, 2(3): August, 1943.

34. Estimation of clean fleece weight from unscoured fleece weight and staple length, Clair E. Terrill, E. M. Pohle, L. O. Emik and L. N. Hazel, submitted to Journal of Agricultural Research for acceptance.

# PROJECT SUMMARIES FOR 1943

## PROGRESS OF INBRED LINES

The number of inbred lines was reduced from 37 to 30 in the fall of 1942 by eliminating or combining those which showed the least promise of developing into useful lines. There was a decrease in inbreeding in the more inbred lines through the changing of sires. However, a larger proportion of all offspring were inbred, because many of the lines are producing an increasing number of inbred offspring so that the average inbreeding coefficient of all offspring increased from 8.62 percent in 1942 to 8.87 in 1943. Significant line differences were found for each of the characters considered (page 14).

## INBREEDING IN RAMBOUILLETS

Highly significant negative correlations were found between inbreeding and grease fleece weight, body weight, and staple length. Body type decreased in merit with inbreeding. There was a tendency for open face and smoothness to increase with inbreeding. Preliminary theoretical considerations indicated that selection could counteract or more than counteract the detrimental effects of inbreeding on fleece and body characters in range sheep (page 15).

## EFFECT OF OUTCROSSING INBRED EWES

The results indicate that outcrossing restored in one generation the loss in vigor which was apparently a consequence of inbreeding. Several complicating factors caution an over-optimistic interpretation of these results (page 16).

## SELECTION OF RAMBOUILLETS IN INBRED LINES

Data are presented on the selection of Rambouillet ram lambs in 1942. The advantage in merit of the saves over the culls is given for the more important traits (page 17).

## HERITABILITY OF FLEECE AND BODY CHARACTERISTICS OF RAMBOUILLET SHEEP

Estimates are presented on heritability of fleece and body characters based on 1622 daughter-dam comparisons. These estimates ranged from 12 percent for type score and 26 percent for neck folds to 40 percent for body weight. In general, these estimates are sufficiently high that, if true, considerable progress can be expected from careful selection for the traits studies (page 17).

PROGENY TESTING OF RAMBOUILLET SHEEP

Summaries were completed during the year on 143 sire progenies. Of 60 rams tried in test pens 27 percent were used in lines, and 17 percent were held in reserve (page 18).

OVERSHOT JAWS

In a study of 43 normal skulls and 8 skulls showing jaw inequalities averaging 1.2 cm. overshot it has been determined that the area involved in the defect in the specimens studied is in general restricted to the interalveolar space in the mandible (page 19).

SKIN FOLDS

Progress in producing sheep free from skin folds has been stepped up conservatively 100 percent from 1937 to 1942. In 1942 84 percent of the weanling lambs were free from folds or had only a trace of neck folds (scores 1 & 2). In 1938 39 percent of the weanling lambs were scored as having moderate to heavy folds, whereas in 1942 only 16 percent received this score. Selection for the useful characteristics will be less hampered when this burdensome obstruction is eliminated (page 20).

HORNS IN RAMBOUILLETS

A total of 41 offspring were weaned from the 2 polled lines in 1942. About half of the ram lambs were polled, and slightly over half of the ewe lambs had depressions instead of horn knobs. Polled ram lambs were used in these lines in the fall of 1942 (page 21).

REPRODUCTIVE CAPACITY OF RAMS AS INDICATED BY SEMEN TESTS

Semen tests made in 1942 showed that yearling rams produced poorer semen than older rams or ram lambs. Changes in management have been made to help correct this condition. It appears that fertility tests alone with other improvements in management have increased the lamb production of the Laboratory flocks (page 21).

CLEAN WOOL DETERMINATIONS

Percentage clean yield was determined for 791 wool samples and 10 half fleeces during the 1943 fiscal year (pages 23 & 26).

NEW CLEAN-YIELD METHOD

A new method for estimating clean-fleece weight from grease-fleece weight and staple length has been developed (pages 23 & 32 & publication No. 34 for details). This method will greatly facilitate the scouring routine, and it offers possibilities of rather general application.

METHODS OF MEASURING WOOL QUALITY

2464 wool samples were analyzed during the year for fiber quality (page 24).

REVISION OF FIBER STRIP FOR COMPARATOR METHOD

The film strip developed for use in the comparator method for determining wool qualities has been revised (page 24).

NEW SAMPLING METHOD FOR WOOL QUALITY STUDIES

The efficiency of sampling a fleece has been facilitated by the use of blending samples from different parts of the fleece (page 24).

WOOL CHARACTERISTICS FOR 1942 and 1939-'40-'41

Staple length has increased 1/4 inch and clean yield .83 pounds. This accounts for an increased value of $.98 per fleece when clean wool sells for $1.18 per pound (page 24).

PROGRESS IN LONG STAPLE LINE

A consistent increase in length and clean fleece weight is noticeable in the yearling progeny for 1939-42 (page 25).
in
SCOURING THE 1942 CLIP BY GRADES

The clean fleece yield of all sheep in the research program for 1942 is available on pages 28 and 29. This information shows the relationship between grade and clean yield and shows obvious reasons why such information is useful in merchandising wool.

SIGNIFICANCE OF CLEAN YIELD AND GRADE ON VALUE OF A FLEECE

Data are presented showing the price relationship that obtains between fleeces that vary in clean yield and grade (page 31).

STAPLE LENGTH AND ITS INFLUENCE OF YIELD AND VALUE

Data from 1147 Rambouillet yearling ewes show that each 1/2 inch increase in length of staple accounts for 1 additional pound of grease wool, 0.7 pound increase in clean scoured wool, and a decrease of 3.3% in shrinkage (page 32).

CLEAN WOOL VARIATION AMONG REGIONS OF RAMBOUILLET FLEECES

The highest clean yields were obtained from the shoulder, thigh, withers, and belly. Lowest yields occurred on the rump, side and back. The average yield of the shoulder, side, and back were nearer the yield of the entire fleece than was any one region (page 32).

ESTIMATION OF CLEAN-FLEECE WEIGHT FROM GREASE-FLEECE WEIGHT AND STAPLE LENGTH

By the use of a nomograph which has been prepared from data on the relationship between grease weight, clean weight, and staple length and formulas to annual variations in shrinkage the clean weight can be estimated almost as accurately as it can be determined by scouring small samples (page 32).

FIBER DENSITY IN RAMBOUILLET SHEEP

In the Rambouillet yearling ewes studied the average density of eight regions was 5255 fibers per square centimeter (page 32).

METHOD OF DETERMINING FINENESS AND UNIFORMITY IN THE ENTIRE FLEECE

A composite sample made up of locks from different areas carded together proved highly satisfactory in representing the fleece as a whole (page 33).

HAIRY BIRTH COAT IN LAMBS

Lambs that are "slightly hairy" at birth seldom retain this condition up to the weaning age. "Moderate" and "extreme" hairy coats will often exhibit the tendency at weaning time (page 34).

SUMMARY OF EWES IN BREEDING PENS - SPECIAL RESEARCH PROJECT
1942-43 Breeding Season

| Pen No. | Ram No. | No. of Ewes | Type Score | Yearling body wt. (lbs.) | Adj. fl. wt. (lbs.) | Adj. fl. length (cms.) | Inbreeding coefficient Dams | Inbreeding coefficient Offspr. | Age of Ewes at Lambing |
|---|---|---|---|---|---|---|---|---|---|
| 18 | 521RW | 22 | 2.36 | 79.59 | 8.90 | 6.00 | 17.87 | 19.02 | 3.77 |
| 18- | 438WP | 8 | 2.54 | 77.12 | 7.87 | 4.99 | 21.85 | 0.00 | 4.25 |
| 19 | 487RW | 27 | 2.31 | 84.30 | 8.14 | 5.78 | 16.36 | 23.03 | 4.63 |
| 20 | 460RW 88RW | 26 | 2.33 | 83.73 | 8.88 | 5.99 | 7.45 | 10.74 | 4.38 |
| 21 | 578RW | 21 | 2.33 | 84.55 | 8.92 | 6.71 | 6.23 | 9.93 | 3.95 |
| 22 | 179RW | 31 | 2.44 | 85.03 | 9.77 | 6.21 | 7.12 | 10.54 | 3.52 |
| 22- | 2965W | 23 | 2.52 | 80.96 | 8.54 | 5.93 | 4.39 | 1.97 | 3.30 |
| 23 | 438RW | 28 | 2.24 | 85.07 | 9.06 | 5.73 | 8.68 | 13.88 | 4.61 |
| 24 | 757RW | 27 | 2.37 | 85.92 | 9.34 | 6.13 | 10.83 | 13.69 | 4.30 |
| 25 | 2885W | 30 | 2.32 | 88.93 | 9.48 | 5.92 | 0.83 | 8.13 | 4.03 |
| 26 | 2439W | 31 | 2.41 | 92.16 | 9.85 | 5.84 | 0.00 | 3.63 | 5.19 |
| 27 | 556RW | 30 | 2.38 | 88.73 | 9.53 | 5.95 | 11.60 | 15.48 | 4.73 |
| 28 | 3566W | 29 | 2.31 | 93.69 | 9.63 | 5.67 | 3.67 | 11.01 | 4.55 |
| 29 | 466WP | 30 | 2.31 | 89.43 | 9.67 | 6.01 | 0.38 | 6.67 | 4.63 |
| 32 | 542RW 708RW | 27 | 2.46 | 84.33 | 9.65 | 5.79 | 7.68 | 10.92 | 4.70 |
| 34 | 926RW | 26 | 2.26 | 87.04 | 8.68 | 6.14 | 11.45 | 14.61 | 3.77 |
| 35 | 2673W | 29 | 2.24 | 93.45 | 8.87 | 5.64 | 2.59 | 9.54 | 3.72 |
| 36 | 3806W | 29 | 2.47 | 89.14 | 9.12 | 5.91 | 1.32 | 7.43 | 4.69 |
| 37 | 3773R | 30 | 2.07 | 87.87 | 9.44 | 6.27 | 1.01 | 17.50 | 3.50 |
| 39 | 2398W | 29 | 2.50 | 86.29 | 9.20 | 5.82 | 2.59 | 6.36 | 4.52 |
| 40 | 2539W | 31 | 2.39 | 93.03 | 9.56 | 5.81 | 0.42 | 8.00 | 4.16 |
| 40- | 3389W | 25 | 2.43 | 86.60 | 8.98 | 5.93 | 1.62 | 0.24 | 3.24 |
| 42 | 2222W | 30 | 2.22 | 89.50 | 9.18 | 5.75 | 0.52 | 5.25 | 3.87 |
| 43 | 3218W | 30 | 2.33 | 87.23 | 8.62 | 5.73 | 0.83 | 7.50 | 4.87 |
| 44 | 3409W | 30 | 2.33 | 85.52 | 9.58 | 5.98 | 2.59 | 5.85 | 3.33 |
| 45 | 438WP | 30 | 2.39 | 88.27 | 9.54 | 5.91 | 0.12 | 6.67 | 5.03 |
| 46 | 9384 | 30 | 2.48 | 86.70 | 9.42 | 5.82 | 0.19 | 9.47 | 5.30 |
| 47 | 2219W | 29 | 2.33 | 85.14 | 8.74 | 6.80 | 2.21 | 11.74 | 3.07 |
| 49 | 2533W | 30 | 2.41 | 91.63 | 9.84 | 5.47 | 0.00 | 1.15 | 5.30 |
| 50 | 2716W | 30 | 2.22 | 86.57 | 9.12 | 5.96 | 2.50 | 7.08 | 4.00 |
| 51 | 4185W | 30 | 2.38 | 89.70 | 9.25 | 6.27 | 2.41 | 7.62 | 3.00 |
| 53 | 4095W | 24 | 2.33 | 85.71 | 9.52 | 5.94 | 0.00 | 1.04 | 4.79 |
| 54 | 4677W | 21 | 2.35 | 89.10 | 9.32 | 6.02 | 0.32 | 0.00 | 4.67 |
| | TOTAL | 903 | 2.35 | 93.30 | 9.22 | 5.93 | 4.21 | 8.87 | 4.23 |

DEVELOPMENT OF SPECIAL RESEARCH PROGRAM

There has been a gradual but consistent increase in the inbreeding coefficient since the Laboratory program was started. The total increase from 1938 to 1943 has been 5.16 percent. The inbreeding has not progressed far enough to bring about any appreciable divergence in lines, nor noticeable defects that can be consistently ascribed to inbreeding. The differences that obtain in body and wool characteristics between lines cannot be ascribed to inbreeding.

In the selection of weanling ram lambs in the fall of 1942 the 92 ram lambs that were saved for prospective sires had an inbreeding coefficient of 6.94, while 317 ram lambs that were sold had a coefficient of 7.36. While it did occur that those selected as saves had a lower inbreeding coefficient, it would hardly be correct to say that the degree of inbreeding was responsible for the difference in the appearance of the lambs. The higher coefficient of inbreeding is given the preference when other things are equal.

| | | Inbreeding Coefficients in Percent | | | |
|---|---|---|---|---|---|
| Year Lambed | Potential Inbred Flocks | Ave. of Progeny | Increase Daughters over Dams | Highest for any Pen | Highest for any Individual |
| 1938 | 20 | 3.92 | 2.83 | 13.30 | 37.9 |
| 1939 | 22 | 7.24 | 4.05 | 30.29 | 58.3 |
| 1940 | 34 | 8.25 | 4.70 | 32.58 | 58.3 |
| 1941 | 36 | 8.56 | 5.85 | 31.17 | 47.3 |
| 1942 | 37 | 8.62 | 4.67 | 28.71 | 39.9 |
| 1943 | 30 | 8.87 | 4.66 | 23.02 | 36.9 |

PROGRESS OF INBRED LINES

The number of inbred lines was reduced from 37 to 30 in the fall of 1942 by eliminating or combining those which showed the least promise of developing into useful lines. Lines 30 and 20 were related and were combined into line 20. Lines 41 and 35, both started with Candland rams, were combined into line 35. Lines 31, 33, 38, 48 and 52 were dropped. The best ewes from these lines were used in related lines, and the others were either culled or utilized in test pens.

The average inbreeding coefficient for all offspring in 1943 was 8.87 percent, while the comparable figure for 1942 was 8.62 percent. The average inbreeding coefficient for 1942 offspring was above 12.5 percent in 7 lines, ranged from 6.25 to 12.5 percent in 17 lines, and was below 6.25 percent in 6 lines. Only one line in the last group (Flock No. 54 - polled) had no inbred offspring. The number of lines in the respective groups for 1942 was 13, 11, and 13.

There has been a decrease in inbreeding in the more inbred lines chiefly through the changing of sires. However, most of the lines have been underway long enough that the proportion of offspring which is inbred is rapidly increasing so that there is a slight increase in the inbreeding of all offspring. These changes are shown by the proportion of ewes making up the various matings. About 7 percent of the ewes were mated to their sires, 30 percent to half brothers, 34 percent to less closely related rams, and 29 percent to unrelated rams. Similar percentages for 1942 were 11, 26, 23, and 40 respectively.

The first 6 lines for each of the more important characters are listed in the following table for comparison with a similar table presented in 1942. These ranks are based on the averages from yearling ewe offspring from 33 lines evaluated in 1941.

| CHARACTER | RANK OF LINE | | | | | |
|---|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | 5th | 6th |
| | Flock Numbers | | | | | |
| Body weight | 34 | 35 | 43 | 29 | 42 | 40 |
| Body type | 42 | 28 | 29 | 43 | 50 | 25, 44 |
| Clean fleece weight | 47 | 20 | 30 | 45 | 46 | 21 |
| Staple length | 21 | 47 | 45 | 29 | 20 | 24 |
| Open face | 40 | 51 | 44 | 31 | 32 | 20 |
| Freedom from folds | 21 | 37 | 45 | 28 | 48 | 51 |

Again, about two-thirds of the lines were included in the table, although 5 of the lines included in 1941 were replaced in 1942. The 4 lines appearing 3 times were 20, 21, 29, and 45.

Significant sire or line differences were found for each of the characters considered--namely, face covering score, staple length, grease fleece weight, clean fleece weight, body type score, and neck folds score. Data were used from yearling ewes evaluated in 1940, 41, and 42. It seems probable that these differences are due more to differences in the original selections of animals to make up the various lines than to the effect of inbreeding in pulling the lines apart.

## INBREEDING IN RAMBOUILLETS

Since many breeding investigations with farm livestock have shown that inbreeding has a detrimental effect upon individual merit, this problem may be one of the most important confronting the Laboratory. Data on 754 yearling ewes evaluated in 1940, 41, and 42 were studied to determine the effect of inbreeding on more important body and fleece characters. The intra-sire, intra-year correlation and regression coefficients between percent inbreeding and the various traits were as follows:

| CHARACTER | CORRELATION COEFFICIENT | REGRESSION COEFFICIENT |
|---|---|---|
| Grease fleece weight | -.24 | -.05 pounds |
| Body weight | -.19 | -.27 pounds |
| Body type score | .15 | .01 score |
| Staple length | -.12 | -.01 cm. |
| Neck folds score | -.15 | -.01 score |
| Face covering score | -.07 | -.006 score |

All of the correlations except that between inbreeding and face coverings were statistically significant, but they are small enough to allow much variation in the traits independently of inbreeding. The regression coefficients show the relative change in the various traits with each increase of one percent in inbreeding. The positive coefficients for body type indicate a decrease in merit with increasing inbreeding. The regressions of neck folds and face covering on percent of inbreeding show a tendency for smoothness and open face to increase with inbreeding. The negative regressions for the other traits indicate a decrease in merit as inbreeding progresses.

It appears possible that, on the average, selection may counteract or more than counteract the decrease in staple length, grease fleece weight, and body type score due to inbreeding where inbreeding increases about 1 percent per year or 4 percent per generation. This statement is based on a theoretical consideration of the amount of selection possible in these lines when selecting for 6 traits and on preliminary estimates of heritability. A gain of about 0.07 centimeter in staple length and 0.76 pound in body weight and a loss of 0.003 pound of grease fleece weight and 0.01 score for body type in each generation was indicated. These are estimates of average results based on average conditions which apply at the present time. It would be expected that some lines would do better and some poorer than these estimates indicate.

In general, regression coefficients of the various characters on inbreeding were lower for yearling ewes in 1942 than in the 2 previous years. This may have been caused to some extent by increased culling of weanlings in 1941, as in general the culled lambs have a little higher average inbreeding coefficient than the lambs which are saved.

## EFFECT OF OUTCROSSING INBRED EWES

Inbred ewes which were small in size, apparently in part as a result of inbreeding, were mated to an unrelated ram in 1940 and 1941. These ewes had averaged about 8 pounds lighter at weaning time than the ewes which were left in the inbred line. They were 28 percent inbred as compared with 23 percent for the dams of the inbred lambs and 31 percent for the inbred lambs. The outcross offspring averaged about 6 pounds heavier at weaning than the offspring from the inbred line and about 15 pounds heavier than their dams, having approximately the same weaning weight as the average of Rambouillet lambs from all inbred lines.

The main purpose of the matings described above was not that of contrasting the effects of inbreeding with outcrossing, but rather to utilize some of the smaller inbred ewes for introducing new blood into the line. While the results indicate that outcrossing restored in one generation the loss in vigor which was apparently a consequence of inbreeding, several factors prevent too exact an interpretation. The dams of the outcross lambs were expected to have smaller offspring as a direct result of their own lighter weight, although some regression toward the population mean was expected. On the other hand, the ram used for the outcross was one of the best rams in the flock (as judged by progeny test). Consequently, the effects of decreased inbreeding and hybrid vigor cannot be appraised exactly. An additional reason for avoiding an over-optimistic interpretation is that the results are based on only 24 offspring.

## SELECTION OF RAMBOUILLETS IN INBRED LINES

A study is underway to determine the amount of selection which is actually practiced within the inbred lines of the Laboratory flocks. Results have been summarized for ram lambs weaned in 1942. A total of 92 ram lambs was saved out of 409 head, or 22.5 percent. The percentage of single lambs saved was 23.1, as compared with 21.6 percent of the twin lambs. In general, there was little difference between singles and twins in the average merit of the lambs saved and culled. The lambs which were saved had an average advantage of 0.08 score for face covering, 0.37 centimeter of staple length, 5.09 pounds of body weight, 0.53 score for body type, and .66 score for neck folds. The saved lambs had an average inbreeding coefficient of 6.94 percent, while the culled lambs averaged 7.36 percent.

## HERITABILITY OF FLEECE AND BODY CHARACTERISTICS OF RAMBOUILLET SHEEP

Estimates have been obtained on the heritability of fleece and body characters based on daughter-dam comparisons of 1622 yearling ewes born from 1938 to 1941. Intra-sire, intra-year correlation and regression coefficients of daughters on dams are presented in the following table:

| CHARACTER | r | b |
|---|---|---|
| Face covering score | .26 | .16 |
| Staple length | .20 | .18 |
| Grease fleece weight | .19 | .14 |
| Clean fleece weight* | .23 | .19 |
| Body weight | .19 | .20 |
| Body type score | .08 | .06 |
| Neck folds score | .16 | .13 |
| Body folds score | .17 | .16 |

* Coefficients for clean fleece weight are based on 310 head in 2 years.

All of these coefficients are highly significant. The regression coefficients show the average change in the daughters with each unit change in

the dams. These are highest for characters which are measured objectively, such as body weight, clean fleece weight, and staple length. The figures for grease fleece weight are lower than those for clean fleece weight, as would be expected, because variations in grease, dirt, and moisture affect the weight of the unscoured fleece.

In general, the correlation coefficients are slightly larger than the regression coefficients, because the dam's variance was greater than the daughter's. This might be expected, as yearly variations were controlled for the daughters, but only partially so for the dams. The greatest differences occur for face covering score and grease fleece weight. Thus, the correlation coefficients may be more accurate estimates of heritability than the regression coefficients. However, the regression coefficients give the more conservative estimates, and these might be more useful until further studies are completed.

Estimates of heritability, or the proportion of the variance among the records of the dams which was due to additively genetic differences among these ewes, were obtained by doubling the intra-sire, intra-year regression coefficients. These estimates ranged from 12 percent for type score and 26 percent for neck folds to 40 percent for body weight. In general, these estimates can be considered to be fairly high. Further studies, which are now being made, may substantiate these estimates or produce more reliable values. It does appear that the heritability for the traits of greater economic value in range sheep is sufficiently high that considerable progress can be expected from careful selection for these traits.

PROGENY TESTING OF RAMBOUILLET SHEEP

Summaries of the results of progeny tests have been completed during the year for 143 sire progenies, of which 66 were based on yearling records and 77 on weanling records. Again emphasis has been placed on body weight, mutton type, grease fleece weight, length of staple, face covering, and skin folds.

Less than half of the sire progenies mentioned above were from test pens. Five of the 29 rams having results from test pens in 1942 based on yearling ewes were used in lines, and 2 were held in reserve. Ten of the 31 rams having results from weanling lambs were used in lines, and 8 were held in reserve. Thus, of the 60 rams tested 27 percent were used, and 17 percent were retained for possible use.

A total of 232 rams were available for 28 lines in the fall of 1942. (Ram lambs were used in the other 2 lines). Of these, 105 had been progeny tested, and 28 were used in lines, and 26 were held in reserve. Of the 127 rams without progeny tests 3 were used in lines; 6 were tested; and 33 were held in reserve. Some difficulty was experienced in obtaining satisfactory semen tests from yearling rams; therefore, ram lambs were used in 19 of the 25 test pens last fall. Satisfactory lamb crops were obtained from nearly all of the ram lambs. There will be considerable practical advantage in testing the best ram lambs which are sufficiently developed to breed satisfactorily, and it is probable that this practice will be continued.

OVERSHOT JAW STUDY

In an analysis of 15 skulls of mature Rambouillet ewes from which all flesh had been removed, from 27 skulls of sheep of the Southdown, Hampshire, and Rambouillet breeds, and from 8 Rambouillet ewe skulls which averaged 1.2 cm. overshot, some information is available which appears to establish the bone area in which the jaw inequality occurs in the overshot jaws studied. Six different measurements were made of the mandible, including the angles of the teeth attachment and mandible, and 8 were made of the maxilla.

In general, the only relationship that appeared in the analysis between parts of the normal skull and parts of the defective skull which showed significant disparity was the relationship between the interalveolar spaces (space between the cheek teeth and incisors and between the molars and the anterior end of the premaxilla, the latter comprising the anterior end of the palatine process plus the body of the premaxilla which articulates with it).

In the 43 normal skulls that have so far been studied it was found that the interalveolar space is about 84 percent the length from the molars to the end of the premaxilla, while in a study of 8 skulls that were overshot 1.2 cm. the alveolar space was only about 74 percent of the interalveolar space of the maxilla, a difference of about 10 percent.

It has been found in the overshot specimens studied so far that the interalveolar space is 29.7% of the length of the mandible, whereas in the normal skulls it is about 28.5%. This difference is probably not very significant. Likewise, in the overshot specimens the interalveolar space of the maxilla is 26.2% of the total skull length (occipital bone to premaxilla), and in the normal skulls it is 26.1%. In all specimens studied there has been perfect registering of the anterior cheek teeth and molars, which apparently shows quite clearly that the inequality in length is generally limited to the interalveolar in the cases studied. (A detailed analysis and a discussion of the methods involved in this study are now in the process of preparation.

While a study of the inheritance is under way, there is not yet available an adequate supply of data from which to draw reliable conclusions other than that the inheritance appears to be complicated. While it may appear to be recessive, it is definitely not a simple recessive, as defective parents have had normal progeny. The possibility of two or more dominant genes, each one of which must be present at least in the heterozygous condition, and other complicated types will not be overlooked in the analysis.

FACE COVERING IN RAMBOUILLETS

In order to make the results of this study available in a convenient form each year, the results for each year will be provided in table form with explanations.

| Year weaned | Open faces | Partially covered faces | Covered faces |
|---|---|---|---|
| 1938 | 14 | 58 | 28 |
| 1939 | 11 | 50 | 39 |
| 1940 | 11 | 34 | 55 |
| 1941 | 11 | 40 | 49 |
| 1942 | 17 | 40 | 43 |

The lamb crop in 1938 was in considerable part from a group of ewes which had originally been included in the program that were relatively openfaced, but which were of the R.S. and Ramb. series carrying some outcrosses of crossbred influence. These were withdrawn from the research lots the following year. This in part at least explains the change from 14 to 11 percent openfaced lambs from 1938 to 1939.

A relatively large number of openfaced rams were used in the fall of 1941, which explains the large percentage of openfaced lambs in 1942. However, while the 17 percent seems very encouraging for the immediate future, there are other matters involved that interfere with the apparent progress. Some of the openfaced rams sired a relatively high percentage of wrinkles, making it advisable to cull in spite of the openfaced character. The percentages given in the table include all lambs and not only those in flocks headed by openfaced rams.

In order to disseminate the openfaced character throughout the population, 82 covered face ewes from various lines were distributed among the lots headed by the openfaced rams. These ewes produced offspring which scored as follows: 26% open face, 47% partially covered, and 27% covered face. These figures are encouraging and offer sound basis for hope of substantial progress in accord with the availability of openfaced rams that prove good sires of all utility characteristics.

SKIN FOLDS

The scores in the accompanying table show clearly that progress has been made in the effort to eliminate the neck folds. While there is some occilation in the yearly scores, particularly in 1939, the general trend has been toward more smoothness. The scores for body folds, while not included in the table, show a similar trend and are obviously less in evidence than are neck folds.

There is a tendency for Rambouillets to have folds immediately below the eyes. These give rise to fly trouble and are most common in wool-blind sheep. The sheep are scored for these face folds and as well for thigh folds that are formed immediately inside of the thigh in the twist region. These folds serve no useful purpose and will be eliminated with all other skin folds. It can be stated with a reasonable degree of accuracy that, when the neck folds disappear, there is also a tendency for all skin folds to disappear. The elimination of these obstructions will increase the opportunity for selection of useful characteristics.

Table Showing Distribution of Neck Folds in Rambouillets in Percent

| Year weaned | Practically no folds score (1) | Trace of folds (2) | Moderately heavy folds (3) | Fairly heavy folds (4) | Heavy folds (5) |
|---|---|---|---|---|---|
| 1938 | 20 | 41 | 27 | 10 | 2 |
| 1939 | 43 | 32 | 20 | 4 | 1 |
| 1940 | 21 | 38 | 29 | 9 | 3 |
| 1941 | 34 | 38 | 22 | 5 | 1 |
| 1942 | 56 | 28 | 12 | 3 | 1 |

There has been an increase of more than 100 percent in smoothness since 1938. In 1938, 39 percent were scored as having moderate to heavy folds, as compared with 16 percent in 1942.

HORNS IN RAMBOUILLETS

Two polled lines of Rambouillets were initiated in 1941 by mating 45 Rambouillet ewes which carried the polled character to two outstanding horned rams. A total of 41 offspring were weaned from these lines in 1942. Eight of the 16 ram lambs had horns, and 8 did not. Fourteen of the 25 ewes were polled, and the remaining 11 had horn knobs. These results agree closely with the expected numbers if the horns in the male and the knobs in the female are due to one pair of recessive genes. The two best ram lambs without horns were used in these lines in 1942-43. It is probable that a few of the lambs produced in 1943 will be homozygous for the polled character.

REPRODUCTIVE CAPACITY OF RAMS AS INDICATED BY SEMEN TESTS

Semen tests were obtained on 116 rams prior to the 1942 breeding season. A total of 403 ejaculates were obtained which were evaluated for volume, appearance, viscosity, pH, motility, concentration and percent of abnormal spermatozoa. Concentration, motility, total spermatozoa produced, and morphology of spermatozoa were the main factors considered in predicting fertility.

Twenty-four rams or 20.7% of the total tested were considered unfit for use in breeding from their semen tests. Four other rams which were expected to be of low fertility were used for a part of the breeding period, and all of these sired offspring, although in one case only one lamb was produced.

Summaries of lambing are not yet complete; therefore, final breeding results are not yet available. A preliminary inspection revealed that of the 92 rams used one ram failed to produce any offspring, and 3 rams were definitely of low fertility. One of these, as noted above, was expected to be of low fertility and was used only for part of the period.

A study was made of the effect of age on semen production of the rams tested in 1942. In each breed the yearling rams produced semen of poorer quality than the older rams or ram lambs. Ram lambs produced over twice as many sperm per ejaculate as yearling rams. One-third of the yearling rams tested were considered unfit for breeding, as compared with 16 percent of the mature rams and 20 percent of the ram lambs. Changes have been made in the management of yearling rams which should correct this condition.

It is difficult to appraise the benefits derived from fertility tests of rams, as information is not available on the results that would have obtained if no tests had been made. A number of checks have been made of rams expected to be of low fertility, and, in general, the expectations have been substantiated, although most of these rams sired some lambs. The number of ewes which became pregnant from pen breeding has increased from 86 to 92 percent in the last 3 years over the 10-year period from 1929 to 1938. Improvements in management apart from the testing of the rams for fertility undoubtedly account for part of this increase. A previous study has shown that about 62 percent of the dry ewes may be attributed to faults of the ewe, leaving 38 percent which may be due to ram failures. If these figures are correct, we could not expect over 95 percent of the ewes to become pregnant if the rams were of perfect fertility. It appears then that we are approaching maximum fertility in so far as percent of pregnancies are influenced by the ram.

PRODUCTION INCREASES FOR RAMBOUILLET FLOCK

In any improvement program that is based on production records it is imperative that production performance of the individuals involved be in line with good management and the environment at hand. It is essential, too, for measuring the value of a breed, and in the application of progeny tests.

| Year | No. of lambs | Ave. weaning weight | Pounds of lamb per ewe bred | Percent of Lambs weaned, based on ewes bred |
|---|---|---|---|---|
| 1924-31 | 2313 | 71.2 | 51.4 | 72.2 |
| 1938 | 602 | 64.63 | 50.86 | 78.69 |
| 1939 | 588 | 64.56 | 46.20 | 71.60 |
| 1940 | 696 | 78.10 | 65.60 | 83.60 |
| 1941 | 768 | 76.43 | 65.70 | 85.90 |
| 1942 | 955 | 75.09 | 70.09 | 93.35 |

(The above weights were made at about 135 days, when the ram lambs had to be removed from the flock, at which time weaning weights are taken on the ewe lambs also, and should not be confused with weights that are taken somewhat later when market lambs come off the range).

The essential increase over the figures reported for 1924-31 in U.S.D.A. Circular 308 is in the pounds of lamb produced per ewe bred, namely 20, and in the percent of lambs weaned based on ewes bred, which

has increased from 72.7 to 93.35. Production in 1938-39 was not normal because of the disturbance created by having to weigh the lambs every two weeks for normal growth studies.

CLEAN WOOL YIELD DETERMINATIONS

There were 791 wool samples and 10-half fleeces scoured for the Rambouillet sheep in the different lines of breeding during the 1943 fiscal year. Percentage clean yield in the small side sample was used in determining the total amount of clean wool in each fleece.

Results were obtained by weighing the grease wool, scouring each sample by the emulsion process (scouring bowls illustrated in 1939 annual report) with a neutral soap and soda ash solution. A small revised Wilson-type fleece opener or duster was used in opening the wool preparatory to scouring (illustrated in 1940 annual report). Clean bone-dry weights were obtained by subjecting all samples to heat treatment in a wool conditioning oven that drove off all moisture. The wool was weighed on a chain-o-matic balance mounted on the conditioning oven before being exposed to moist air. The percentage clean yield of the small samples times the grease fleece weight of each sheep gave the amount of clean wool produced by each animal.

NEW CLEAN-YIELD METHOD ADOPTED

A method of estimating clean-fleece weight from grease-fleece weight and staple length for the fleeces of yearling ewes at Dubois, Idaho, has been developed. Basic data on clean-yield results from yearling fleeces over a 3 year period (1939-41) were used in developing the method.

The clean-yield estimation method was used in the sampling procedure on the 1943 yearling ewe fleeces. It consisted of sampling 30 head of yearling ewes, selected at random, for each breed. Therefore, it has reduced the time and labor previously required for sampling, scouring, and calculating, which is an important factor, especially during wartime.

Annual corrections for variations in clean-wool yields will be made from formulas based on clean yields from 30 samples for each breed and on annual variations in grease fleece weight and staple length.

A nomograph has been developed for the rapid estimation of clean-fleece weight which is read directly by laying a ruler or straight-edge extending from the grease fleece weight across to the staple length at the side so the clean-fleece weight can be read from the middle of the nomograph for each respective breed (reference 34, list of publications).

While the method outlined is general, the wide applicability of the equations can be tested for different localities only by developing similar equations for flocks in widely separated regions. Wool laboratories maintained in most of the important sheep-producing states can perform valuable service in this respect, thereby placing the selection of improved breeding stock and the marketing of wool in the grease on a more reliable basis than is possible where individual clean-fleece weights

and average clean yield are not known. (Reprints will be mailed to collaborators as soon as available).

METHODS OF MEASURING WOOL QUALITY

A total of 2464 wool samples were analyzed in the animal fiber laboratory for fineness, uniformity and medullation determinations. The samples were cleaned in carbon tetrachloride and cross-sections were made for each sample. Fineness, uniformity and medullation were determined by the Rapid Comparator method (reference 14).

REVISION OF FILM STRIP WOOL STANDARDS

Revision of the 35 mm. film strip of wool standards was accomplished so that certain frames on the standards would present a more detailed outline of the fibers. The new revised film strips will be available upon request by the collaborating stations in exchange for the strips that they now have.

NEW SAMPLING METHOD ADOPTED FOR QUALITY APPRAISAL IN FLEECES

Results in a study of wool fineness from 8-body regions in Rambouillet yearling ewes (reference 31) indicated that wool from several locations over the body gave more reliable results and represented more accurately the major portion of a fleece from breeding sheep than does one sample. Samples were taken from (1) the middle of the shoulder, (2) middle of the back, and (3) over the hip bone from all of the rams and yearling ewes for 1943. Thigh samples from Rambouillet yearling ewes were eliminated because the variation in the Laboratory flock has been well within the variability standards of the ASTM and USDA with the exception of an occasional hairy britch which can be detected with the naked eye. Thigh samples were taken from all rams and will be evaluated individually.

Results of blending tests carriedout at the Laboratory with wool samples from various body regions by use of hand wool cards showed that blended samples gave a more representative appraisal of the fleece (reference 30). Therefore, the technique that will be used is as follows: Equal portions of the 3 major samples will be blended by hand carding. One cross-section of the composite sample will be made and fineness, uniformity, and medullation determined from the blended sample. Heretofore, fineness samples were taken from the side and thigh regions only.

WOOL CHARACTERS FOR 1942 and 1939-1940-1941

Reference is made to the summary of wool characters for the 1942 yearling Rambouillet ewes. Averages are included for each of the 3 preceding years for each character, adjusted to 365 days growth. The average grease fleece weight in 1942 was 1 pound lighter than for 1939, the lowest year reported, and 1.45 pounds lighter than 1941, the year they were the heaviest. The importance of basing individual wool production on a clean wool (fleece) basis for testing progeny is demonstrated by the variation in clean wool yield for Rambouillet yearling ewes of approximately the same breeding for

the different years. The average clean yield varied 15.2%, or from 35.5% in 1939 to 50.7% in 1942. Most of the difference is due to seasonal variation, but it will be noted that staple length has steadily increased for the last 3 years from 2.17 inches to 2.41 inches, or about 1/4 inch, which is a significant increase for fine-wool sheep. This added length has had some influence on the clean fleece weight, which has been raised .83 pounds, from 3.17 to 4.0 pounds, or an increase of $.98 per fleece when fine-wool sells at $1.18 per clean pound.

The widest spread in clean yield between any two consecutive years occurred in 1941 and 1942. The grease weights show an advantage of 1.45 pounds for 1941 and nearly 10% difference in clean wool yield between the two years. However, the clean fleece weights varied but .14 pounds, which signifies the animals' wool producing ability to be about equal for each of the two years. The results are very significant and point out that if clean wool yield is not determined annually for fleeces from breeding sheep much information will be lost on their true wool producing ability.

The fineness and variability changed but slightly. Clean fleece weights, fineness, variability, and medullation determinations are used in the selection and culling program as well as in progeny studies. The low producers are subject to culling before the breeding season.

LONG STAPLE LINE COMPARED WITH OTHER LINES

Sheep being bred and designated as pen 21 have demonstrated the ability to transmit the long staple character to their offspring. In comparing various wool characters for the four years it will be noted that an increase has been shown for length of staple and clean fleece weight, and in all but one year the grease fleece weight was greater.

Average of Yearling Progeny for Special Research Lines
(adjusted to 365 days growth)

| Pen 21 year | No. head | Staple length (cms) | Staple length (inch) | Grease fleece weight (lbs.) | Clean fleece weight (lbs.) |
|---|---|---|---|---|---|
| 1939 | 11 | 6.51 | 2.56 | 9.30 | 3.14 |
| 1940 | 16 | 6.78 | 2.67 | 9.55 | 3.81 |
| 1941 | 8 | 6.63 | 2.61 | 10.21 | 3.76 |
| 1942 | 7 | 7.21 | 2.84 | 8.05 | 3.98 |
| All others | | | | | |
| 1939 | 303 | 5.50 | 2.17 | 8.94 | 2.76 |
| 1940 | 282 | 5.68 | 2.24 | 9.12 | 3.07 |
| 1941 | 290 | 5.99 | 2.36 | 9.34 | 3.45 |
| 1942 | 274 | 6.13 | 2.41 | 7.89 | 3.57 |

Summary of Wool Characters for 1942
Yearling Rambouillet Ewes and for the Years 1941-1940-1939
(Adjusted to 365 Days Growth)

| Years | 1942 | | | 1941 | 1940 | 1939 |
|---|---|---|---|---|---|---|
| Fleece Characters | Low | High | Mean | Mean | Mean | Mean |
| Fleece weight (grease) lbs. | 5.07* | 10.63 | 7.89 | 9.34 | 9.12 | 8.94 |
| Fleece weight (clean) (Bone dry) lbs. | 2.24 | 5.07 | 3.57 | 3.45 | 3.07 | 2,76 |
| Commercial for breed** | 2.52 | 5.64 | 4.00 | 3.86 | 3.52 | 3.17 |
| Clean yield (Bone dry) % | 34.1 | 56.2 | 45.3 | 36.8 | 33.8 | 30.9 |
| Commercial for breed** | 38.9 | 62.2 | 50.7 | 41.4 | 38.6 | 35.5 |
| Staple length (cm.) | 4.1 | 8.2 | 6.13 | 5.99 | 5.68 | 5.50 |
| " " (inches) | 1.61 | 3.23 | 2.41 | 2.36 | 2.24 | 2.17 |
| Fineness side (microns) | 16.0 | 23.0 | 18.7 | 18.6 | 19.9 | 19.0 |
| Fineness thigh (microns) | 16.0 | 25.0 | 20.6 | 21.1 | 21.9 | 21.1 |
| Variability side (std. dev.) | 1.5 | 5.5 | 2.3 | 2.4 | 2.9 | 2.7 |
| Variability thigh (std. dev.) | 1.5 | 8.0 | 4.7 | 4.8 | 4.7 | 4.8 |

* The incidental low producers that appear in the records as yearlings are subject to culling before the breeding season. They may occur in unthrifty sheep or in small twins.

** Corrected according to method advanced for side samples by Schott, Pohle, Spencer, and Prier, (reference 23), and reported on commercial basis with ~~12%~~ moisture added to bone-dry weights.

a content of 12%.

Grease fleece weight increased from 1939 to 1941, but in 1942 all fleece weights were lighter; nevertheless, the clean yield was higher. This is reflected in the clean fleece weight, which was greater than for any previous year.

The average for all of the progeny shows a steady increase for the four years which has resulted in increased wool production for the entire group. The increase in staple length for pen 21 and the average of all progeny from 1939 to 1942 was approximately 1/4 inch for each group and .82 pound increase in clean fleece weight for each group.

GRADING OF THE 1942 CLIP

Information relative to the commercial grades of fleeces produced by each breed of yearling sheep and mature ewes is tabulated below. Due to the interest of collaborators in the entire program being carried on by the WSPL and USSES, the grade information of the Cross-bred breeds is also included.

Commercial Grades and Average Grease Fleece Weight of 1942 Ewe Fleeces in Percent

| Commercial Grade | Rambouillet | | Targhee | | Corriedale | | Columbia | | All |
|---|---|---|---|---|---|---|---|---|---|
| | Yrlg. (%) | Mat. (%) | Yrlg. (%) | Mat. (%) | Yrlg. (%) | Mat. (%) | Yrlg. (%) | Mat. (%) | |
| Fine strictly combing | 58 | 29 | 1 | 4 | | | | | |
| Fine French combing | 41 | 69 | | 2 | | | | | |
| Fine clothing | 0 | .5 | | | | | | | |
| 1/2 blood | 1 | 1.5 | 79 | 91 | 12 | 39 | 7 | 12 | |
| 3/8 blood | | | 20 | 2 | 80 | 50 | 75 | 53 | |
| 1/4 blood | | | | | 8 | 11 | 18 | 31 | |
| Low 1/4 blood | | | | | | | | 4 | |
| Average grease fleece weight (lbs.)* | 8.75 | 9.21 | 8.80 | 9.45 | 8.63 | 9.55 | 10.10 | 10.49 | 9.23 |
| Total sheep | 520 | 1832 | 61 | 226 | 50 | 171 | 169 | 514 | 3535 |

* Not adjusted to 365 days.

The average age of all yearling Rambouillet ewes was slightly over 13 months; thus, their fleeces graded a higher percentage of fine staple combing than the fleeces from the mature ewes which were of 12 months' growth. Numerous fleeces from the mature Rambouillet ewes were "borderline" fleeces and could have been graded as strictly combing or French combing. Many French combing fleeces were on the high side of French which, it is believed, attributed to the but slight difference in the clean yield between the Strictly Combing and French Combing.

These grades of wool and breeds of sheep were produced under practically the same conditions. The chart above gives an idea of the mixture of grades that might be contained in a commercial flock when there are different breeds included in the same flock. This fact is particularly noticeable when the wool is not graded before going into the bag. Since wools when sold are figured on a clean basis, the difficulty of estimating or arriving at a reasonably accurate clean wool yield figure for such a mixture of wool in the same bag may be observed from the clean yield results on foregoing pages for the various grades of wool. If the sheep had not been first segregated according to breed by running them through a dodge gate before being shorn and the fleeces graded on the shearing floor and sacked by grade, the variation in grade in each bag could have been from Fine French to Low 1/4 Blood with a clean wool yield variation of 13% (44 to 57%).

1942 CLIP SCOURED BY GRADE

Reliable grade and clean yield information by breed for entire clips of range wool has been recognized as an important factor in the production and marketing of wool. The further need for this type of information was illustrated on page 28 of the June 30, 1942, annual report, in which the shrinkage estimates placed on the wool by the selling agency and the scouring results from 5-bag test lots of each grade of wool showed a wide range. Incidental to the Western Sheep Breeding Laboratory program involving Rambouillet Fine wools there is included for the interest of the collaborators a summary for wools of the U. S. Sheep Experiment Station produced by the Targhee, Corriedale, and Columbia breeds.

In 1942 each grease fleece was commercially graded as it was weighed, and a separate clean yield was obtained for each grade for all breeds and sexes by a reputable commercial wool scouring plant on the Atlantic coast. The identification, amount of grease wool, and commercial clean yield for each lot of the entire clip are included in the following table:

Commercial Clean Yield for the 1942 Wool Clip
by Grade, Breed and Sex

| Lot No. | Identification | Amount in lot (lbs.) | Commercial scouring results 1942 Clean Yld.% | 1941 5-bag lots Clean Yld.% |
|---|---|---|---|---|
| 1 | Lamb. Mat. Ewe, Fine Str. Comb. | 5,065 | 45.51 | |
| 2 | " " " , " French " | 11,297 | 44.50 | 42.6 |
| 3 | " Yrlg. " , " Str. " | 2,544 | 45.34 | |
| 4 | " " " , " French " | 1,557 | 44.29 | |
| 5 | " Yrlg. & Mat. Ram, Fine Str. " | 2,626 | 44.65 | |
| 7 | Targhee Ewe, Mat. & Yrlg., Bulk 1/2 Blood | 4,164 | 48.57 | 47.3 |
| 8 | Corriedale Ewe, Mat. & Yrlg., Bulk 3/8 Blood | 1,606 | 49.13 | |
| 10 | Columbia Ewe, Mat. & Yrlg., Bulk 3/8 Blood | 3,808 | 51.98 | 51.2 |
| 11 | " " , Mat. & Yrlg., Bulk 1/4 Blood | 2,663 | 57.40 | 52.4 |
| 12 | Targhee, Corriedale & Columbia Ram Wool, 1/2, 3/8 & 1/4 Blood | 2,432 | 48.10 | |
| 13 | Mature Ewe crutchings | 1,569 | 36.17 | |
| 14 | All tags and sweepings | 1,121 | 31.37 | |
| 15 | Black, brown and grey | 325 | 42.54 | |
| | All Lots | 40,777 | 46.34 | |

There was only 1% difference in clean wool yield between the Fine Strictly combing and Fine French combing wool (lots 1 and 2) for the mature Rambouillet ewe fleeces, and this same 1% difference existed between the yearling fleeces (lots 3 and 4) for the same grade designations. This small spread between Strictly combing and French classification may be due largely to the great number of "borderline" fleeces that could have been called either Fine Staple combing or Fine French combing.

The clean yield for the mature ewe fleeces was nearly identical with the yearling fleeces for the same classification--that is, for Strictly combing or French combing. The same type of wool had a 2½% higher clean yield in 1942 than in 1941.

Lot No. 5 of Fine combing Rambouillet ram wool yielded 44.65%, or approximately the same as the ewe wool. This coincides with previous findings in the wool from the Rambouillet rams of this Laboratory and is far from the general belief in the trade, where fine wool ram fleeces are generally discounted (see Schedule of Values, which are ceiling prices of Domestic Shorn Wool used in appraising for C. C. C., corrected copy as of April 26, 1943, where they have fine wool buck classified among off-wool such as tags, crutchings, eye clippings, etc.). However, due to limited information on ram fleece yield in commercial flocks some

discount may still be justified in sale channels, as environmental conditions vary. Here is another opportunity to be of service to the producer.

CRUTCHING OF EWES

All mature ewes were crutched in March, 1942, and approximately 1/2 pound of wool was clipped from each ewe. This wool was not included with the fleece weights; therefore, the grease fleece weight for each mature ewe shows approximately 1/2 pound lighter than the actual wool produced for the year. Prior to 1942 the ewes were all tagged at lambing, but the amount of wool removed was not so great. From clean yield data presented elsewhere in this report results show that crutchings contain a higher percentage of clean wool than do straight tags.

SIGNIFICANCE OF CLEAN YIELD AND GRADE ON VALUE OF FLEECE

The following data provide a comparison of grease and clean fleece weights by grades of wool and the clean fleece value for each grade and breed. This is the first year that complete grade and clean yield information has been available for the entire clip to show such a comparison within and between grades of wool and breeds of sheep. After several years of such data it will be valuable in pointing out yearly variation in wools produced on the same range and its importance to sheep breeders for range production purposes and especially when marketing wools. It will further point out clean yield variations within and between grades of wool and the importance of grading fleeces before sacking so that a more reliable estimate of clean yield can be made when selling wool in the grease.

Due to the Collaborators' interest in the entire program at this Station, information is included for all 4 breeds maintained at this Station.

1942 Grease and Clean Fleece Weights Based on Commercial Scouring Results, Grade of Fleece and Fleece Values, figured at 1942 Ceiling Prices for Ewes

| Grade | Yearling | | | | Mature | | | |
|---|---|---|---|---|---|---|---|---|
| | Grease Wt.* (Lbs) | Clean Wt. (Lbs) | Clean Value per Lb. | Average Clean Fleece Value** | Grease Wt.* (Lbs) | Clean Wt. (Lbs) | Clean Value per Lb. | Average Clean Fleece Value** |
| Rambouillet | | | | | | | | |
| Fine Strictly Combing | 9.07 | 4.11 | $1.18 | $4.85 | 9.15 | 4.16 | $1.18 | $4.91 |
| Fine French Comb. | 8.27 | 3.66 | 1.13 | 4.14 | 9.12 | 4.06 | 1.13 | 4.59 |
| Fine Clothing | | | | | 9.33 | 3.92 | 1.08 | 4.23 |
| 1/2 Blood | 9.79 | 4.70 | 1.15 | 5.41 | 9.30 | 4.37 | 1.15 | 5.03 |
| Average | 8.75 | 3.90 | $1.15 | $4.49 | 9.21 | 4.10 | $1.15 | $4.72 |
| Targhee | | | | | | | | |
| Fine Strictly Combing | 5.50 | 2.49 | 1.18 | 2.94 | 9.60 | 4.35 | 1.18 | 5.13 |
| 1/2 Blood | 8.80 | 4.25 | 1.15 | 4.89 | 9.50 | 4.61 | 1.15 | 5.30 |
| 3/8 Blood | 9.09 | 4.47 | 1.04 | 4.65 | 9.80 | 4.81 | 1.04 | 5.00 |
| Average | 8.80 | 4.27 | $1.12 | $4.78 | 9.45 | 4.59 | $1.15 | $5.28 |
| Corriedale | | | | | | | | |
| 1/2 Blood | 8.37 | 4.07 | 1.15 | 4.68 | 9.56 | 4.64 | 1.15 | 5.34 |
| 3/8 Blood | 8.64 | 4.24 | 1.04 | 4.41 | 9.52 | 4.68 | 1.04 | 4.87 |
| 1/4 Blood | 9.43 | 5.41 | .96 | 5.19 | 9.37 | 5.38 | .96 | 5.16 |
| Average | 8.63 | 4.24 | $1.04 | $4.41 | 9.55 | 4.69 | $1.04 | $4.88 |
| Columbia | | | | | | | | |
| 1/2 Blood | 8.69 | 4.22 | 1.15 | 4.85 | 9.63 | 4.68 | 1.15 | 5.38 |
| 3/8 Blood | 9.94 | 5.17 | 1.04 | 5.38 | 10.57 | 5.49 | 1.04 | 5.71 |
| 1/4 Blood | 10.91 | 6.26 | .96 | 6.01 | 10.60 | 6.08 | .96 | 5.84 |
| Low 1/4 Blood | | | | | 12.47 | 7.16 | .92 | 6.59 |
| Average | 10.10 | 5.45 | $1.04 | $5.67 | 10.49 | 5.66 | $1.04 | $5.89 |

* See high clean yield for 1942 on page 29.

** Average clean fleece value arrived at by dividing total pounds of grease wool produced by actual number of ewes X percentage clean yield X clean valu

Average of entire clip containing 3535 fleeces:
Grease fleece weight-9.23 pounds, based on individual scale weights for each fleece.
Clean fleece weight-4.28 pounds, based on shrinkage of total clip, including tags, crutchings, blacks, etc.

STAPLE LENGTH--ITS INFLUENCE ON GREASE WEIGHT, SHRINKAGE AND FLEECE VALUES

In fine-wool produced under range conditions from 1,147 Rambouillet yearling ewes for four years (1938-41) each half-inch increase in staple length was responsible for 1.0 pound increase in grease wool, 0.7 pound increase in clean scoured wool, and a decrease of 3.3% in shrinkage. When the fleeces were grouped according to grade, the average clean fleece value per fleece for the Strictly Fine Combing staple wool was $5.00, for French Combing wool $3.56, and for short wool, approaching Clothing length, $2.92. This represents a difference of $2.08 per fleece between Fine Combing and the shortest, or clothing, fleeces, and $1.44 between Fine Combing and Fine French Combing. Length is, therefore, a very vital factor in clean yield and value per fleece (Nat. Wool Grower, 33;6, June, 1943-Pp 22-24).

CLEAN WOOL YIELD VARIATION AMONG REGIONS OF RAMBOUILLET FLEECES

A group of Rambouillet yearling ewes were sampled from 8 regions on the body to determine the variability of clean wool yield within the fleece and the relative reliability of samples from the various regions for predicting the clean wool yield of the entire fleece of breeding sheep. Highest clean yields were obtained from the shoulder, thigh, withers and belly. Lowest yields were obtained from the rump, side and back. Variation among regions and individuals was highly significant. Variation among regions was greater than among individuals. Average yields of all 8 regions and also of the shoulder, side and back regions were nearer to that of the entire fleece than any one region. These variations reflect the need of having adequate sampling methods for determining clean yield in fleeces of breeding sheep (reference 32).

ESTIMATION OF CLEAN-FLEECE WEIGHT FROM GREASE-FLEECE WEIGHT AND STAPLE LENGTH

A method was developed for the estimation of clean-fleece weight based on the multiple regressions of clean-fleece weight on grease-fleece weight and staple length. The multiple correlation coefficient for Rambouillets was 0.81. A nomograph was prepared for the rapid estimation of clean-fleece weight. Formulas were developed to take into account annual variations in grease-fleece weight, staple length, and clean wool yield, as determined by scouring samples from a small group of ewes from each breed. The accuracy of grease-fleece weight and staple length for predicting clean-fleece weight was only slightly less than that expected from scouring a small sample to obtain the clean-wool yield for each fleece. It is expected that this method will contribute greatly to the efficiency of the program by reducing costs without interfering with efficiency (reference 34).

FIBER DENSITY IN RAMBOUILLET SHEEP

Results obtained for fiber density in a representative group of Rambouillet yearling ewes from 8 regions on the body, sampled with 3 different instruments, shows an average density of 5255 fibers per square centimeter. The order of density for the different regions (reported in number of fibers) was: withers-6321, rump-6115, hip-6055, shoulder-5544, back-5265, side-5237, thigh-3864, and belly-3643. Increasing the number of sheep,

the number of positions, the number of locks, and the size of the skin area from which a lock was cut were all shown to increase the accuracy. Three square centimeters of skin area per lock appears to be the optimum area to sample. The Wyedesa caliper appeared to be somewhat more accurate than the Wira or Hairpin calipers for determining density (reference 33).

## WOOL FINENESS STUDIES IN RAMBOUILLET BREEDING SHEEP

In a special study of fineness variation in yearling Rambouillet fleeces to determine a working index for selection of experimental breeding sheep studies were made between sheep, regions (8), locks (3), cross-sections, and groups to determine the minimum number of locations to sample and the number of fibers that would adequately represent a fleece. Results indicate that measuring more than 100 to 200 fibers decreases the standard error but slightly, which indicates that measuring the fibers from more than one cross-section at a particular region and level is not efficient sampling technique. Samples from one level and two regions are required to obtain a standard error of 0.692, which is consistent with the range usually observed in fine wool sheep. Samples from the shoulder, side and thigh rank sheep in approximately the same order as the average of samples from the eight regions studied. For comparing individual fleeces several regions and levels must be sampled to make differences of from two to three microns significant at the 5% level. Results show that for comparing fleeces from groups of sheep, such as a progeny group, at least ten sheep per group are required to make a difference of one micron significant for a reasonable number of regions and levels (reference 31).

## METHOD FOR DETERMINING FINENESS AND UNIFORMITY IN THE ENTIRE FLEECE

Various methods of sampling individual fleeces and measuring fineness and uniformity were investigated. Trials indicated that small locks of wool from different body regions on a fleece could be hand carded with satisfactory results. Also, several methods of determining fineness and uniformity were tested as to accuracy, rapidity and application on large numbers of sheep. Both the count and rapid comparator methods of determining fineness and uniformity were sufficiently accurate to distinguish between uniform and variable fleeces and are applicable for field conditions where large numbers of animals must be considered (reference 30).

## CLEAN YIELD AND FINENESS DETERMINATIONS IN ZONED AREA SAMPLES

Ten yearling Rambouillet ewe fleeces were random selected for a fleece zoning study. One-half of each fleece was separated into small portions (zones) and the remaining one-half of the same fleece scoured intact. This study was initiated to secure basic information relative to the most representative area on the fleece from which to obtain samples for clean yield and fineness determinations. The analysis of these data has not been completed.

This study is being continued in 1943 with 10 head of yearling Rambouillet ewes.

HAIRY BIRTH COAT IN LAMBS

All lambs were scored for hairiness in the fleece at the time of docking They were again observed at weaning and as yearlings. Fleeces of lambs at weaning were compared with those at docking time for hairiness, and it was generally found that lambs exhibiting hairiness at weaning age had scored as either "moderate" or "extreme" at docking. Seldom did a lamb show hairiness at weaning age when it scored but "slightly" hairy at docking. The types of hairiness displayed at docking age that persist in later months are being studied. Lambs from some rams show a definitely higher percentage of hairiness than do lambs from other rams.

SEMINAR
1942-43

In order to keep informed on the research in livestock production, and more particularly in sheep improvement, a regular weekly seminar period of about two hours is devoted to an organized review of literature during the winter months, at which time field activities do not interfere so much with attendance as they do in the grazing season.

While one member of the staff is assigned as the leader for the topic indicated, the group as a whole make contributions to the assignment in accordance with the time they have available. Each member of the staff is always on the alert, when searching through the various publications, for special items as they relate to the special fields involved in the research and accordingly calls his observations to the attention of the member of the staff that is immediately concerned.

| Date | Topics |
|---|---|
| Dec. 3 | Review of the Regional Swine Breeding Laboratory Meetings. C. E. Terrill. |
| | The Relative Importance of Heredity and Environment in the Growth of Pigs at Different Ages. L. N. Hazel. |
| Dec. 10 | Nutrition of Breeding Rams. J. E. Nordby. |
| Dec. 17 | Reproduction in Sheep. (Flushing). C. E. Terrill. |
| | Report on Semen Testing Research. L. O. Emik. |
| Dec. 24 | " " " " " (continued). L. O. Emik. |
| Dec. 30 | Progeny Testing of Sheep. L. N. Hazel. |
| Jan. 14 | Review of Wool Research. H. H. Keller. |
| | The Effect of Nutrition on Wool Production. E. M. Pohle. |
| Jan. 28 | Increased Profits from Sheep through Progeny Testing and Culling for Production. C. E. Terrill. |
| Feb. 5 | Five Years of Wool Production, on 4 Breeds of Sheep at the U.S.Sheep Exp. Sta. and WSBL and analysis of 1942 Clip by Grade, Breed and Clean Yield. E. M. Pohle. |
| Feb. 18 | The Efficiency of 3 Methods of Selection Applied to Traits in Sheep. L. N. Hazel. |
| May 11 | Discussion and Adoption of Wool Sampling Proposal for 1943. E. M. Pohle. |

U. S. SHEEP EXPERIMENT STATION

It is not possible to make a very specific segregation between the reports of the Western Sheep Breeding Laboratory and the U. S. Sheep Experiment Station. A number of the projects and many of the activities are overlapping. In general, many, if not most, of these are found in the former in order to make it complete, and an effort has been made to avoid a duplication of them in the latter.

ANNUAL REPORT
U. S. Sheep Experiment Station
June 30, 1943

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## THE NEED FOR STABILIZING WOOL AND BODY TYPE IN WHITEFACED CROSSBRED SHEEP FOR WESTERN RANGE PRODUCTION

The early history of the western range sheep industry is essentially one of fine-wool interests. Throughout the pioneering period of sheep husbandry in the west, emphasis was placed primarily on wool, and the interest in "mutton was quite secondary to wool as a market product. Shortly after the turn of the last century, however, a demand was beginning to develop for "lamb". Within a relatively short period of time, an industry that had been emphasizing wool over "mutton" was rapidly beginning to place "lamb" ahead of wool, particularly in the heavy feed-producing areas. The opportunity for the rugged, whitefaced crossbred ewe, with her high potential capacity for lamb and wool production, was definitely at hand.

The term "crossbred" when applied to range sheep has reference to the progeny resulting from the crossing of coarse-wool and fine-wool whitefaced breeds. These are commonly referred to as whitefaced crossbreds, or, in the range country, merely as "crossbreds". The cross has, in general, been effected by breeding purebred coarse-wool rams of the Lincoln, Cotswold or Romney breeds to fine-wool range ewes, and also to purebred or near-purebred fine-wool ewes. Purebred fine-wool rams have also been bred to purebred coarse-wool ewes. The essential difference in the outcome of these crosses has varied somewhat in accordance with the size and type of sheep that were used in the original crosses and in the selections which have been made. The lambs produced from mating coarse-wool rams to ewes of Rambouillet breeding were more growthy, and developed into larger sheep than the progeny of coarse-wool rams and ewes of Merino breeding. There has also been some difference in wool grade objective among breeders.

The first cross ewes, commonly referred to as "straight" crossbreds have proved themselves excellently adapted to a number of areas where feed is relatively abundant, and many ranchmen regard them as the most profitable crossbred in those areas. They are large, comparatively smooth, openfaced and produce, in general, a fleece of good staple length that grades 3/8 and 1/4 Blood. Many of the fleeces are 3/8-1/4 Blood borderline fleeces. The straight crossbred ewes are, in the main, successful lamb producers. Moreover, the "cut" required to make commercial flocks of this cross relatively uniform in body and wool type is fairly small, varying from about 10 percent in the most carefully managed foundation flocks to 25 percent or above in those where less attention is paid to the selection of parental stock. The straight crossbred was also the least complicated to produce of all whiteface crossbreds. But, there were no rams of an established breed available for maintaining the characteristics of this cross. This type continued to be the result of the crossing of two breeds.

The population of crossbred ewes increased so rapidly that it appeared impossible, impractical or both to limit the requirement to straight crossbreds. Moreover, the straight crossbred did not appear to meet with universal acceptance, as many ranchmen preferred to operate with crossbreds that had a larger percentage of fine-wool breeding than the straight crossbred carried. This was not necessarily a matter of arbitrary choice, but rather an effort to produce crossbred ewes that were more suitable to less pro-

ductive range areas than were those where the straight crossbred ewe was at her best. This appeared possible by increasing the percentage of fine-wool influence and thus insuring more hardiness and a relatively "tight" fleece that would not "brush". The only means available of increasing the fine-wool influence was to breed the first cross ewes back to fine-wool rams. But, there was no breed of sheep available that produced rams for maintaining the characteristics of this second cross. Hence, in order to make use of the progeny of first cross ewes and fine-wool rams as flock replacement ewes, the only choice was to breed them to fine-wool rams or coarse-wool rams, and the respective progenies of these two crosses were very different. The problems which faced the ranchmen in producing replacement ewes from the first cross ewe gave rise to some very active exploratory practices in crossbreeding that were subsequently characterized by more or less confusion which left much to be desired in flock type stability.

The backcrossing method involved the breeding of fine-wool rams to first-cross ewes. This cross produced the three-quarter fine-wool-one-quarter coarse-wool cross commonly known as the "comeback". The typical comeback is a little smaller than the straight crossbred and produces, in general, 1/2 Blood wool. It is also somewhat more hardy and has a little longer productive life than the straight crossbred. The comeback ewes fit into many areas where feed is not plentiful enough for optimum production by the straight crossbred. Since there were no three-quarter rams available, however, comeback replacement ewes could be produced only by mating the fine-wool rams to the first-cross ewes, thus requiring two sheep generations for the production of the comeback.

While the whitefaced crossbred sheep industry of the West was very enterprising in the magnitude it assumed, and methods it used, it was unique in so far as it overlooked somewhat the inevitable need for paralleling the development of crossbred ewes with an adequate supply of suitable crossbred rams. It was rather natural that this would happen since there was little crystalized understanding with reference to just what characteristics a crossbred ram should have in body and wool type. Moreover, differences in environmental conditions did not make all areas equally suitable for one type of crossbred. Furthermore, trading in wool was on the "original bag" basis with major emphasis on estimated shrinkage values and with little concern for graded contents, as they may have influenced price differentials. Market requirements at country points were relatively easy to satisfy, except for shrinkage, hence there was very little economic discipline to guide the producer in his choice of grade, and very little encouragement to package a graded, quality product.

The natural result of this definite lack of recognition for intrinsic value in the wool clip did not offer adequate compensation for improving the flocks, nor did it serve as adequate penalty against the further admixtures of breeding. The consequence was not only the rather free use of backcrossing to rams of the foundation breeds, but the use of first and second cross rams, and also rams with almost any combination of whitefaced breeding that it is possible to produce through interbreed and intergrade crossing.

As a result of the admixture of breeding in western whiteface crossbreds it is often necessary, in the production of replacement ewes, to cut back 20 to 30 percent of the ewe lambs as feeders in order to have a fairly uniform band of prospective yearlings. When these are yearlings, often another cut of 10 to 20 percent should be made. If no culling is done before the yearling age, often the cut runs from 30 to 50 percent before a fair degree of uniformity is realized in wool and body type.

The scrambled admixture of parent breeds in the general population of crossbreds is by no means all wrong. Production records prove abundantly that the western whitefaced crossbred sheep are generally very productive of lambs and wool. Even though the methods used in crossing have had no particular design in their aim for maximum production, the crossbreeding that has been done, in the absence of a well-defined method, has been generally fruitful in bringing about a stimulating effect in production under the conditions at hand. There is perhaps no other example of crossbreeding in the annals of livestock husbandry which has been so fruitful of increased total production for the purpose desired.

This extensive admixture of breeding, however, which involved two foundation breeds that were very different in wool and body type, has been equally as productive of variability in body and wool types as it has been stimulating to high total production. Therefore, two well-defined jobs lie ahead. One of these is the matter of maintaining the degree of production that has come about through crossbreeding,--or even exceeding it. And the other job is to narrow down the variations in both body and wool types, and thus stabilize in grade of product so the lambs and the wool are made greatly more uniform than they now are within flocks, within areas, and within the population as a whole.

To accomplish these two jobs this Station has under way a well-organized breeding program involving the production of a substantial number of inbred lines. The fundamental elements of inheritance present that govern high production and prepotency will have opportunity to properly combine when these inbred lines are judiciously crossed. Ewes and rams are rigidly selected from production records, for quality as well as for quantity production, as these are determined by measurable characteristics of practical value. The rams are progeny tested before they are used in a main line. If they pass a breeding test successfully they are used in a main line and become designated as stud rams if they prove worthy of that designation when bred to ewes in a main line.

Considerable courage has been displayed by breeders who have expressed their idea of what constitutes practical merit in crossbred rams by developing crossbred breeds. Among the breeds and strains now available for crossbred ram production are the Corriedales (originating in New Zealand), the Columbia, Panama, Romneldale and Targhee (originating in the United States). The comparatively few flocks involved have already been of considerable service, as their influence has been felt in pointing the way to the stabilizing of body and wool type. But much has yet to be done! The ranchman will be asking where he can procure an adequate supply of crossbred

rams that are well enough bred and carefully enough selected so he can rely upon them for effecting the desired improvement. The breeders of such rams must eventually answer this question. It cannot be answered by the indescriminate use of first-cross rams, nor by back-crossing to the parent breeds.

In an effort to contribute to the solution of the rather complex problems that confront the producers of crossbred sheep, the Bureau of Animal Industry undertook, some thirty years ago, the task of getting fundamental information pertaining to their production, as that might become available through the actual development of crossbreds suitable for range production. This work was done very largely at the U. S. Sheep Experiment Station, Dubois, Idaho, and undertaken in the spirit of orderly investigation and enquiring purpose. The inversigations were made under range conditions where the actual year around range problems had to be faced. The first effort that was undertaken culminated in the development of the Columbia breed. An additional effort, somewhat different in nature, has given rise to the Targhee.

The Columbia is, in general, the result of breeding select Lincoln rams to Rambouillet ewes, and proceeding from this step by mating the most select first-cross rams to carefully selected first-cross ewes, and then interbreeding the most select rams and ewes descending from them. The essential objects were to determine if and also how the commendable qualities of the Lincoln-Rambouillet crossbred could be stabilized into a useful range breed. There were two general methods available that offered possibilities. Either cull lightly and increase numbers rapidly, or cull heavily and accumulate numbers more slowly. The latter was selected as the more basically sound approach from the experimental point of view, as doubtless it would yield maximum progress in stabilizing wool and body type. Throughout the development of the breed, selection has constantly been based on total production of wool and lamb, as that influences the economics of range sheep husbandry.

The foundation of the Targhee was laid by the use of Corriedale, Lincoln, and Rambouillet rams and Corriedale and Rambouillet ewes. Two basic combinations were made. Rambouillet rams were bred to Lincoln-Rambouillet first-cross ewes. And, Rambouillet rams were also bred to ewes that were produced by mating Corriedale rams to Lincoln-Rambouillet first-cross ewes. Rams and ewes from these two combinations of breeding were carefully selected and interbred, and later developed into the Targhee.

The results that have been accomplished in stabilizing the grade of wool in the Targhee should prove encouraging to the ranchman who is interested in producing 1/2 Blood wool. In 1942 the Targhee ewe fleeces were graded 94 percent 1/2 Blood and 6 percent 3/8 Blood. The ram fleeces were graded 99 percent 1/2 Blood and 1 percent 3/8 Blood.

In 1941 and 1942 about three percent of the ewe lambs were culled for fleece irregularities such as shaggy breech, short staple, hairy fleece, wool blindness and for other wool characteristics that were below the standard for stud ewes. Thirteen percent were culled because they were below the required standards for stud ewes in body type. Small size, a low

topline, small bone, steepness in the rump, and wrinkles in the skin about the neck or body constituted the main reasons for culling. Not all animals in breeds that have been established for a long time meet stud requirements.

There is a very definite need for a well-organized effort to improve the type of wool and body conformation in whitefaced crossbred range sheep. That this can be done appears evident from the production records of the Columbias and Targhees which show that very substantial progress has been made in producing stability of wool and body type in two lines of cross breeding, both of which originated from admixtures of two or more breeds that were substantially different in wool and body type. The records also show that this has been accomplished under range conditions by pursuing a well-defined objective in an orderly manner, and, briefly herein lies the solution for stabilizing the grade of wool and the body type of the white-faced crossbred sheep of the West.

# PROJECT SUMMARIES FOR 1943

## PROGRESS IN LINES OF COLUMBIA, TARGHEE, AND CORRIEDALE

The inbreeding coefficient of all Columbia progeny was 8.8 percent, or 5.7 percent over their dams and 2.5 percent over last year (page 42).

The coefficient of inbreeding of the Targhee progeny was 10.3 percent, as against 9.0 percent of 1942 (page 42).

The inbreeding coefficient of Corriedale progeny was 8.9 percent, which was 1.7 percent lower than in 1942 and 4.8 percent higher than for the dams in 1943 (page 42).

## HERITABILITY OF FLEECE AND BODY CHARACTERISTICS OF RANGE SHEEP

This study shows results consistent with those for the Rambouillets, but further analysis of a larger group of data is needed (page 44).

## PROGENY TESTING OF RANGE SHEEP

While not so many test ewes are available in these breeds as in the Rambouillet, progeny tests are made of as many rams as possible. In so far as it is possible rams are tested before they are used in the main lines (page 45).

## OCCURRENCE OF BROWN COLOR IN RANGE SHEEP

There has been a reduction of brown spots in the Corriedale progeny but very little change in the Columbia and Targhee progeny (page 45).

## PHOSPHORUS INVESTIGATIONS WITH RANGE SHEEP

Blood phosphosur levels were fairly definite and variations between seasons were highly significant (page 46).

## CLEAN WOOL YIELD AND FINENESS DETERMINATIONS

Percentage clean yield was determined for 509 wool samples and 10 half fleeces. Fiber quality was determined for 1640 wool samples in the three crossbred breeds during the 1943 fiscal year (page 46).

## NEW CLEAN YIELD METHOD ADOPTED

A new method for estimating clean fleece weight from grease-fleece weight and staple length has been developed, (pages 23 & 32 & publication No. 34 for details). This method will greatly facilitate the scouring routine, and it offers possibilities of rather general application (page 46).

## REVISION OF FILM STRIP FOR COMPARATOR METHOD

The film strip developed for use in the comparator method for determining wool quality has been revised (page 24).

WOOL CHARACTERS FOR 1942 and 1939-'40-'41 FOR 3 BREEDS

Staple length, clean wool per ewe, and clean yield have increased in each of the 3 breeds. The importance of annual determinations of clean wool yield are pointed out (page 47).

GRADING OF THE 1942 CLIP

The commercial grade of fleeces produced by each breed of sheep is presented. The Targhee breed graded the highest percentageof one grade of wool, which was 1/2 Blood; the Corriedale followed with predominately 3/8 Blood and the Columbia principally 3/8 Blood. The importance of grading wool before sacking and marketing is demonstrated (page 50).

SCOURING OF THE 1942 CLIP BY GRADE

The clean fleece yield of all sheep for 1942 is available on page 29. This information shows the relationship between grade and clean yield and shows obvious reasons why such information is useful in merchandising wool (page 50).

SIGNIFICANCE OF CLEAN YIELD AND GRADE OF VALUE OF A FLEECE

Data are presented showing the price relationship that obtains between fleeces that vary in clean yield and grade (page 31).

STAPLE LENGTH AND ITS INFLUENCE ON YIELD AND VALUE

Data for each breed of sheep show the increase in wool production and value for each $\frac{1}{8}$-inch increase in staple length (page 51).

WOOL SAMPLING REGIONS IN 4 BREEDS OF SHEEP

Lowest clean yields were obtained from the withers, back and rump. The differences in accuracy among the shoulder, side, back, hip or belly were very small compared with the entire fleece (page 52).

ESTIMATION OF CLEAN-FLEECE WEIGHT FROM GREASE-FLEECE WEIGHT AND STAPLE LENGTH

By the use of a nomograph which has been prepared from data on the relationship between grease weight, clean weight, and staple length and formulas to annual variations in shrinkage the clean weight can be estimated almost as accurately as it can be determined by scouring small samples (page 32).

HAIRY BIRTH COAT IN LAMBS

Lambs that are "slightly hairy" at birth seldom retain this condition up to the weaning age. "Moderate" and "extreme" hairy coats will often exhibit the tendency at weaning time (page 34).

PROGRESS IN DEVELOPING LINES OF COLUMBIA, TARGHEE AND CORRIEDALE SHEEP

Matings of Columbias were made in the fall of 1942 with 10 lines and 5 test pens. All ewes included in lines were the result of 2 or more top-crosses of Columbia rams. Ewes from 1 Columbia topcross on the Lincoln-Rambouillets or Corriedale-Lincoln-Rambouillets were all bred in test pens. A total of 357 ewes were bred in lines and 153 in test pens as shown in the following summaries.

There was little difference in the average merit of Columbia ewes bred in 1942 as compared with 1941. The type score was slightly better and the staple slightly longer. In addition the ewes were younger in 1942. The ages of the ewes were reported as of their last birthday at breeding time in 1941. This was changed to the age at lambing in the tables (1942) presented here. Thus, the age of the ewes given in this report is generally equal to the interval between generations, which was approximately 4 years for all ewes in Columbia breeding.

The average inbreeding coefficient of all Columbia offspring was 8.8 percent which represented an increase of 5.7 percent over their dams and 2.5 percent over last year. This increase is much greater than that for the Rambouillet lines. The more rapid increase in inbreeding in the Columbias may be attributed in part at least to the relatively small number of important sires to which most of the animals trace and to the fact that no Columbia lines were started with outcrosses. Little evidence has been obtained yet on any change of merit with inbreeding.

Targhees were bred in 8 lines and 1 test pen in the fall of 1942 involving 225 ewes. The average increase in inbreeding of the offspring over their dams was 6.8 percent, which was the highest of the 4 breeds. The average inbreeding coefficient of all Targhee offspring, except first crosses, was 10.3 percent, as compared with 9.0 percent for last year.

The numbers of Targhees are being increased by the use of selected Rambouillet and Columbia rams and Corriedale, Lincoln-Rambouillet, and Rambouillet ewes. Thus, one of the best Rambouillet rams available was mated to 35 Corriedale ewes. A Targhee ram was topcrossed to 12 Lincoln-Rambouillet ewes and 2 of the best Columbia rams were mated to 41 Rambouillet ewes. These were the top ewes from the group of over 700 test Rambouillet ewes. A considerable effort is being made to insure that superior individuals are used to increase the base of the Targhee breed.

The number of Corriedale lines was decreased from 5 to 4 in the fall of 1942 including 98 ewes. The average inbreeding coefficient of all Corriedale offspring was 8.9 percent, which was 4.8 percent higher than for the dams and 1.7 percent lower than last year. The decrease was probably due to the fact that the Corriedale line showing the least promise was also the most inbred. However, the best ewes from this line were used in related lines and in the production of first-cross Targhees.

Significant line differences are not pronounced yet in these breeds. Analysis of covariance within each breed and year for 5 traits showed

insignificant sire differences in the majority of cases. Differences were apparent, however, which may become significant when larger numbers can be included.

Summary of Ewes in Columbia Breeding Pens
1942-43 Breeding Season

| Pen No. | Ram No. | Type ewes | No. ewes | Type score | Yearling body weight (lbs.) | Yearling adj. fleece weight (lbs.) | Yearling adj. fleece length (cms.) | Inbreeding coefficient Dams % | Inbreeding coefficient Offspring % | Age of ewes at lambing (years) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3477K | K | 20 | 1.82 | 102.25 | 10.65 | 9.05 | 17.89 | 17.67 | 4.00 |
| | | K2 | 22 | 1.97 | 103.64 | 11.58 | 9.46 | 0.92 | 7.67 | 3.41 |
| 2 | 3283K | K | 20 | 2.11 | 101.32 | 10.94 | 9.08 | 6.08 | 16.21 | 3.50 |
| | | K2 | 11 | 1.82 | 94.45 | 9.13 | 9.75 | 0.65 | 13.55 | 2.27 |
| 3 | 3387K | K | 20 | 2.00 | 97.50 | 9.82 | 8.75 | 9.33 | 18.58 | 3.65 |
| | | K2 | 15 | 1.69 | 105.80 | 11.81 | 10.10 | 0.57 | 9.29 | 3.13 |
| 4 | 3242K | K | 24 | 2.11 | 99.04 | 10.28 | 9.17 | 6.63 | 15.84 | 3.33 |
| | | K2 | 15 | 1.82 | 95.87 | 10.10 | 9.80 | 0.69 | 14.63 | 2.00 |
| 5 | 3310K | K | 20 | 2.07 | 100.15 | 10.21 | 8.42 | 4.20 | 12.88 | 3.75 |
| | | K2 | 28 | 1.93 | 92.93 | 9.36 | 9.61 | 0.60 | 13.36 | 2.36 |
| 6 | 2895K)3418K) | K | 12 | 1.89 | 102.33 | 10.77 | 8.62 | 9.13 | 10.75 | 3.17 |
| | | K2 | 16 | 2.06 | 101.13 | 11.12 | 8.75 | 0.00 | 12.24 | 4.36 |
| 7 | 3773K | K | 17 | 2.08 | 95.35 | 9.41 | 9.22 | 10.73 | 16.81 | 3.88 |
| | | K2 | 14 | 1.90 | 101.86 | 11.35 | 8.44 | 0.57 | 7.23 | 4.36 |
| 8 | 3054K | K | 19 | 1.98 | 101.58 | 9.87 | 8.49 | 4.59 | 10.81 | 4.00 |
| | | K2 | 18 | 1.87 | 97.50 | 10.98 | 8.42 | 0.91 | 6.13 | 4.00 |
| 9 | 3977K | K | 25 | 2.00 | 99.28 | 10.19 | 8.98 | 5.10 | 7.06 | 3.56 |
| | | K2 | 8 | 2.04 | 95.25 | 11.31 | 8.01 | 0.39 | 2.24 | 3.75 |
| 10 | 3134K | K | 21 | 1.92 | 100.81 | 10.02 | 8.13 | 4.32 | 6.56 | 4.57 |
| | | K2 | 10 | 1.86 | 95.40 | 10.50 | 8.61 | 0.31 | 1.46 | 4.60 |
| 11 | 3734K | K1B | 18 | 2.08 | 95.22 | 10.04 | 9.35 | 0.00 | 0.62 | 5.89 |
| | | K1L | 13 | 2.02 | 100.23 | 10.69 | 9.18 | 0.00 | 3.39 | 3.31 |
| | | K2 | 1 | 2.00 | 89.00 | 10.18 | 7.90 | 0.00 | 7.90 | 3.00 |
| 12 | 3435K | K1B | 18 | 2.15 | 90.89 | 10.20 | 9.44 | 0.00 | 1.04 | 5.78 |
| | | K1L | 13 | 2.00 | 97.92 | 10.79 | 9.48 | 0.00 | 5.05 | 3.23 |
| 13 | 3522K | K1B | 19 | 2.17 | 90.15 | 10.93 | 9.01 | 0.00 | 1.73 | 5.84 |
| | | K1L | 12 | 2.11 | 95.50 | 10.27 | 9.43 | 0.00 | 4.07 | 3.33 |
| 14 | 3736K | K1B | 17 | 2.12 | 92.47 | 10.34 | 9.22 | 0.00 | 5.82 | 6.00 |
| | | K1L | 12 | 2.06 | 100.92 | 10.39 | 8.88 | 0.00 | 3.02 | 3.33 |
| 15 | 3985K | K1B | 16 | 1.90 | 92.63 | 10.22 | 8.89 | 0.00 | 0.19 | 6.25 |
| | | K1L | 14 | 1.76 | 100.07 | 10.18 | 8.79 | 0.00 | 4.98 | 3.71 |
| TOTALS | | K | 200 | 1.99 | 99.91 | 10.22 | 8.72 | 7.59 | 12.73 | 3.75 |
| | | K2 | 158 | 1.90 | 98.42 | 10.67 | 9.18 | 0.55 | 8.86 | 3.34 |
| | | K1B | 88 | 2.09 | 92.85 | 10.36 | 9.23 | 0.00 | 0.86 | 5.94 |
| | | K1L | 64 | 1.98 | 98.97 | 10.46 | 9.15 | 0.00 | 4.13 | 3.39 |
| GRAND TOTAL | | | 510 | 1.98 | 98.11 | 10.41 | 9.00 | 3.15 | 8.80 | 3.96 |

Summary of Ewes in Targhee Breeding Pens
1942-43 Breeding Season

| Pen No. | Ram No. | Type ewes | No. ewes | Type score | Yearling body weight (lbs.) | Yearling adj. fleece weight (lbs.) | Yearling adj. fleece length (cms.) | Inbreeding coefficient Dams % | Inbreeding coefficient Offspring % | Age of ewes at lambing (years) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1537T) | A | 1 | 2.67 | 71.00 | 7.04 | 9.80 | 6.30 | 0.00 | 2.00 |
| | 1934T) | T | 25 | 1.97 | 92.60 | 10.12 | 7.22 | 5.30 | 13.27 | 4.28 |
| 2 | 1225T | LR | 1 | 2.00 | 95.00 | 10.34 | 3.33 | 0.00 | 0.00 | 8.00 |
| | | T | 25 | 1.95 | 89.52 | 9.13 | 7.86 | 7.00 | 22.46 | 3.72 |
| 3 | 1742T | T | 25 | 2.11 | 91.36 | 9.87 | 7.35 | 2.41 | 10.80 | 3.60 |
| 4 | 1807T | T | 25 | 2.12 | 94.32 | 10.43 | 7.64 | 0.00 | 1.08 | 3.84 |
| 5 | 1492T | T | 24 | 2.04 | 87.29 | 9.23 | 7.37 | 4.91 | 10.68 | 4.13 |
| | | LR | 11 | 2.15 | 95.36 | 10.14 | 9.20 | 0.00 | .34 | 6.82 |
| 6 | 2134T | T | 25 | 2.08 | 91.12 | 9.61 | 8.21 | 0.00 | 9.84 | 3.20 |
| 7 | 1230T | T | 26 | 2.14 | 90.04 | 9.76 | 7.49 | 5.06 | 12.42 | 3.96 |
| 8 | 2068T | T | 27 | 2.02 | 91.93 | 9.75 | 7.42 | 4.40 | 5.82 | 4.15 |
| 9 | 2082T | T | 8 | 2.42 | 82.37 | 8.55 | 6.98 | 3.73 | 2.24 | 3.25 |
| | | T1 | 15 | 1.93 | 90.47 | 9.15 | 8.36 | 0.00 | 3.35 | 2.00 |
| 47- | 2219W | A | 34 | 2.41 | 88.21 | 9.10 | 8.46 | 3.04 | 0.00 | 4.74 |
| 1- | 3477K | S | 20 | 2.30 | 96.60 | 10.04 | 6.74 | 0.39 | 0.00 | 3.40 |
| 8- | 3054K | S | 21 | 2.30 | 94.33 | 10.15 | 6.80 | 0.11 | 0.00 | 3.43 |
| TOTALS | | T | 210 | 2.07 | 90.71 | 9.69 | 7.55 | 3.51 | 10.30 | 3.84 |
| | | A | 35 | 2.42 | 87.71 | 9.04 | 8.50 | 3.15 | 0.00 | 4.66 |
| | | LR | 12 | 2.14 | 95.33 | 10.15 | 8.71 | 0.00 | 3.70 | 6.92 |
| | | T1 | 15 | 1.93 | 90.47 | 9.15 | 8.36 | 0.00 | 3.35 | 2.00 |
| | | S | 41 | 2.30 | 95.44 | 10.10 | 6.77 | 0.25 | 0.00 | 3.41 |
| GRAND TOTAL | | | 313 | 2.14 | 91.16 | 9.66 | 7.64 | 2.74 | 7.12 | 3.91 |

Summary of Ewes in Corriedale Breeding Pens
1942-43 Breeding Season

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3720A | A | 24 | 2.15 | 86.04 | 9.43 | 9.12 | 5.35 | 9.95 | 3.92 |
| 3 | 3666A | A | 24 | 2.19 | 83.25 | 9.73 | 9.93 | 5.52 | 7.66 | 3.71 |
| 4 | 4015A | A | 25 | 2.35 | 82.32 | 9.70 | 9.38 | 3.56 | 12.54 | 3.76 |
| 5 | 3266A | A | 25 | 2.27 | 85.68 | 9.02 | 9.01 | 2.37 | 5.61 | 4.20 |
| TOTAL | | A | 98 | 2.24 | 84.32 | 9.47 | 9.36 | 4.17 | 8.94 | 3.90 |

HERITABILITY OF FLEECE AND BODY CHARACTERISTICS OF RANGE SHEEP

Preliminary estimates have been obtained on the heritability of fleece and body characters based on daughter-dam comparisons of yearling Columbia, Corriedale, and Targhee ewes. The characters studied were staple length, grease fleece weight, clean fleece weight, body weight, and body type score. In general, the estimates were similar to those presented for Rambouillets in the Laboratory report. The intra-sire correlations and regressions were much more variable from year to year than the Rambouillets, probably because of the smaller numbers

involved. Definite results cannot be presented until analysis of a larger group of data can be completed.

## PROGENY TESTING OF RANGE SHEEP

Progeny testing was carried on in the same manner for Columbia, Corriedale, and Targhee sheep as for the Rambouillets. Emphasis was placed on body weight, mutton type, fleece weight and length of staple. Clean fleece weight was given greater emphasis than staple length in the Columbia and Corriedale breeds. Summaries based on yearling offspring have been made from 10 Columbia sires in lines and 6 in test pens, 6 Corriedale sires in 5 lines and from 8 Targhee lines. Weanling results are available from the same number of lines, 8 Columbia test pens and 2 Targhee test pens.

The proportion of test pens to lines is much smaller in these breeds than in the Rambouillets. Therefore, comparisons of the rams own production records must be relied on more for the selection of the line sires. Comparison of the line progenies is used to indicate the rams which are siring lambs which are below average. These poorer sires are then replaced by the best rams available from the respective lines. Greater numbers of Columbia ewes permit a number of test pens for this breed. Ten of the 11 rams used in Columbia lines in 1942 had been progeny tested. The other was a ram lamb.

## OCCURRENCE OF BROWN COLOR IN RANGE SHEEP

The percentage of weaning lambs with brown color for the last four years is shown in the following table:

| Year | Corriedales | Targhees | Columbias |
|---|---|---|---|
| 1939 | 37 | 25 | 17 |
| 1940 | 30 | 25 | 14 |
| 1941 | 28 | 11 | 12 |
| 1942 | 18 | 25 | 16 |

These data show continued decrease in the number of Corriedale lambs with brown color on the face or legs, but no definite change is noted in the other 2 breeds.

A more accurate method of scoring color was used in 1942. The score given at weaning time was checked against the score given at birth so that a reinspection could be made of all those where disagreement occurred. Stains are sometimes present on the face and legs, and working conditions are such at lambing and weaning time that it is often difficult to determine whether or not color is present. A previous study showed that about 11 percent error occurred at each time of observation. It is believed that the use of the above method will reduce this error and that the weaning score may be used as the final color score for each lamb.

## PHOSPHORUS INVESTIGATIONS WITH RANGE SHEEP

A four-year study on the seasonal variation in the blood phosphorus level of range ewes in cooperation with the Idaho Experiment Station was completed in 1942. Blood samples were collected from a group of about 40 Columbia ewes at 3 to 7 different times each year. Analyses of the Phosphorus content of the blood were made by the Idaho Station.

Seasonal trends in blood phosphorus level were fairly definite, and variations between seasons were highly significant. Highest blood phosphorus levels were found on the winter and spring ranges, while lowest levels were found at lambing time, in the late summer and fall, and on the winter feed lot. Supplemental feeding of cottonseed cake or oats on the winter range or feed lot increased the phosphorus content of the blood.

Blood phosphorus was lower for ewes that had lambed than ewes that had not lambed. Dry ewes had higher blood phosphorus than ewes which were pregnant or were suckling lambs. Ewes with one lamb had higher blood phosphorus than ewes with 2 lambs.

Blood phosphorus tended to decrease with age. An increase was noted as the ewes lost weight under winter range conditions.

## CLEAN WOOL YIELD AND FINENESS DETERMINATIONS

There were 509 wool samples scoured from each of the Targhee, Corriedale, and Columbia breeds, and also 10 Columbia half-fleeces. Percentage clean yield in the small sample was used in determining the total amount of clean wool in each fleece. A total of 1640 wool samples were cross-sectioned and evaluated for fineness, variability, and medullation determinations by the Rapid Comparator method.

## NEW CLEAN YIELD METHOD ADOPTED

Refer to pages 23 and 32 and reference 34.

## REVISION OF FILM STRIP WOOL STANDARDS

Refer to page 24.

## NEW SAMPLING METHOD ADOPTED FOR QUALITY APPRAISAL IN FLEECES

Refer to pages 24 and 33 and reference 34. Samples were taken from (1) the middle of the shoulder, (2) middle of the back, (3) over the hip bone, and (4) from the thigh even with the underline from all rams and yearling ewes for 1943. Samples from the shoulder, back, and hip will be blended by hand carding. One cross-section of the composite sample will be made and the fineness, uniformity, and medullation determined from the blended sample. The thigh samples will be evaluated individually.

WOOL CHARACTERS FOR THE TARGHEE, CORRIEDALE, AND COLUMBIA BREEDS OF SHEEP FOR 1942 and 1939, 1940, 1941

Reference is made to the summary of wool characters for the Targhee, Corriedale, and Columbia yearling ewes for 1942 and the averages for the 3 preceding years, adjusted to 365 days growth.

The average grease fleece weight for the Targhee ewes was 1.4 pounds lighter in 1942 than in 1941. However, the clean fleece weight for 1942 was higher than for any of the 3 preceding years. Clean fleece weights have increased from 3.6 pounds in 1939 to 4.3 pounds in 1942, or an increase of 0.7 pound per fleece. The clean yield increased from 38% in 1939 to 54% in 1942. There has been an increase in length of staple from 2.6 inches in 1939 to 3.2 inches in 1942, or a total increase of 0.6 inches. Fineness and variability have changed but slightly.

The grease fleece weights for the Corriedale yearling ewes were 1.50 pounds lighter in 1942 than in 1940, which were the lightest grease fleece weights for any year herein reported. The clean fleece weights for 1942 were but slightly below those for 1941, when they were highest. There was a 0.3 pound increase in clean fleece weight from 1939 to 1942. The clean yield increased from 44% in 1939 to 57% in 1942, or an increase of 13% between the lowest and highest years. Staple length has shown a steady increase from 3.3 inches in 1940 to 4.0 inches in 1942, or an increase of 0.7 inches. Fineness and variability at the side and thigh show a decline.

The 2.5 pound variation in grease fleece weight between years was more pronounced in the Columbia ewes than for any of the 3 crossbred breeds. The range was from 8.9 pounds in 1942 to 11.4 pounds in 1940. This variation was much smaller in the clean fleece weight, where there was only 0.5 pounds spread between 1939, the lowest year, and 1940, the highest year. The average clean yield for 1942 was 53%, and for 1940 it was 42%, or an 11% difference between the highest and the lowest years. Staple length was increased 0.65 inches from 1939 to 1942, when it was the longest. Fineness has changed slightly, and the fleeces average more uniform.

In general, the yearlings of the 3 breeds are producing more clean wool per ewe; the staple length has been increased, and the clean yield has likewise increased. The increase in amount of clean wool and staple length may be attributed to selection, while the clean yield variation is influenced primarily by the climatological conditions. The average between-year clean-yield varied 11% in the Columbia, 13% in the Corriedale, and 16% in the Targhee. In a breeding program where progenies are tested from different sires it is necessary to have a measure of the animal's wool producing ability. The yearly variations in grease fleece weight and clean yield show the importance of measuring an animal's wool producing ability based on clean fleece determinations annually. Not only is it important for culling or selecting breeding animals, but it is equally so when selling wool, because when wool sells for $1.00 per clean pound, each 1% difference in shrinkage changes its grease value 1 cent per pound.

Summary of Wool Characters for 1942 Targhee Yearling Ewes and for the years 1941, 1940 and 1939 (adjusted to 365 days growth)

| Years | 1942 | | | 1941 | 1940 | 1939 |
|---|---|---|---|---|---|---|
| Fleece Characters | Low | High | Mean | Mean | Mean | Mean |
| Fleece Weight (grease) lbs. | *5.10 | 9.63 | 7.96 | 9.39 | 9.92 | 9.44 |
| Fleece Weight (clean) (Bone dry) lbs. | 2.66 | 5.28 | 3.99 | 3.72 | 3.86 | 3.30 |
| **Commercial for breed | 2.91 | 5.71 | 4.33 | 4.08 | 4.23 | 3.63 |
| Clean Yield (Bone dry) % | 41.78 | 59.33 | 50.13 | 39.62 | 38.91 | 34.96 |
| **Commercial for breed | 45.67 | 64.14 | 54.45 | 43.40 | 42.35 | 38.49 |
| Staple Length (cm.) | 6.5 | 11.2 | 8.10 | 7.50 | 7.00 | 6.61 |
| (inches) | 2.56 | 4.41 | 3.19 | 2.95 | 2.75 | 2.61 |
| Fineness Side (microns) | 17.0 | 25.0 | 20.8 | 20.4 | 21.7 | 21.4 |
| Fineness Thigh (microns) | 16.0 | 28.0 | 22.8 | 23.5 | 24.3 | 23.8 |
| Variability side (std.dev.) | 1.5 | 7.5 | 3.5 | 3.2 | 3.7 | 3.9 |
| " thigh " " | 2.0 | 7.5 | 5.2 | 5.5 | 7.2 | 6.1 |

* The incidental low producers that appear in the records as yearlings are subject to culling before the breeding season. They may occur in unthrifty sheep or in small twins.

** Corrected according to method advanced for side samples by Schott, Pohle, Spencer and Brier, (reference 23), and reported on commercial basis with 12% moisture added to bone-dry weights.

a content of 12%

Summary of Wool Characters for 1942 Corriedale Yearling Ewes and for the Years 1941, 1940 and 1939 (adjusted to 365 days growth)

| Years | 1942 | | | 1941 | 1940 | 1939 |
|---|---|---|---|---|---|---|
| Fleece Characters | Low | High | Mean | Mean | Mean | Mean |
| Fleece Weight (grease) lbs. | *5.68 | 10.65 | 7.88 | 9.53 | 9.38 | 9.51 |
| Fleece Weight (clean) (Bone dry) lbs. | 3.04 | 6.30 | 4.18 | 4.25 | 4.04 | 3.88 |
| **Commercial for breed | 3.25 | 6.73 | 4.47 | 4.56 | 4.33 | 4.17 |
| Clean Yield (Bone dry) % | 41.04 | 60.73 | 53.05 | 44.60 | 43.07 | 40.80 |
| **Commercial for breed | 44.07 | 64.78 | 56.70 | 47.81 | 46.20 | 43.82 |
| Staple Length (cm.) | 7.7 | 13.2 | 10.10 | 8.98 | 8.36 | 8.49 |
| " " (inches) | 3.03 | 5.20 | 3.98 | 3.54 | 3.29 | 3.34 |
| Fineness Side (microns) | 16.0 | 25.0 | 19.7 | 21.38 | 22.49 | 21.49 |
| " Thigh (microns) | 18.0 | 29.0 | 22.4 | 24.92 | 25.10 | 24.37 |
| Variability Side (std.dev.) | 1.5 | 6.0 | 3.3 | 3.9 | 4.5 | 4.2 |
| " Thigh " " | 2.0 | 9.5 | 5.4 | 6.2 | 6.1 | 6.1 |

Summary of Wool Characters for Columbia Yearling Ewes

| | | | | | | |
|---|---|---|---|---|---|---|
| Fleece Weight (grease) lbs. | *6.35 | 13.38 | 8.87 | 10.67 | 11.39 | 9.88 |
| Fleece Weight (clean) (Bone dry) lbs. | 2.98 | 6.63 | 4.52 | 4.51 | 4.64 | 4.15 |
| **Commercial for breed | 3.08 | 6.90 | 4.69 | 4.66 | 4.80 | 4.29 |
| Clean Yield (Bone dry) % | 39.52 | 61.99 | 50.96 | 42.27 | 40.74 | 42.00 |
| **Commercial for breed | 40.82 | 64.45 | 52.85 | 43.70 | 42.10 | 43.42 |
| Staple Length (cm.) | 7.6 | 13.1 | 9.53 | 8.29 | 8.33 | 7.87 |
| " " (inches) | 2.99 | 5.16 | 3.75 | 3.26 | 3.28 | 3.10 |
| Fineness Side (microns) | 18.0 | 27.0 | 23.1 | 24.1 | 25.8 | 24.6 |
| " Thigh (microns) | 20.0 | 34.0 | 25.8 | 27.9 | 29.9 | 28.0 |
| Variability Side (std.dev.) | 1.5 | 7.5 | 4.3 | 5.5 | 5.0 | 6.0 |
| " Thigh " " | 3.5 | 9.5 | 6.0 | 7.4 | 8.3 | 7.4 |

* The incidental low producers that appear in the records as yearlings are subject to culling before the breeding season. They may occur in unthrifty sheep or in small twins.

** Corrected according to method advanced for side samples by Schott, Pohle, Spencer and Brier, (reference 23), and reported on commercial basis with 12% moisture added to bone-dry weights.

a Content of 12%

GRADING OF THE 1942 CLIP. Refer to page 27.

The Targhee fleeces from the yearling ewes graded approximately 80% 1/2 Blood and 20% 3/8 Blood, while the fleeces from the mature ewes graded 91% 1/2 Blood, 2% 3/8 Blood, and 4% and 2% Fine combing and Fine French respectively. The explanation for the yearling fleeces grading a higher percentage of 3/8 Blood was probably due to their 13 months of wool growth. Fleeces from mature ewes of the same breeding for a 12 months' wool growth period had a much higher percentage of 1/2 Blood wool. Thus, it appears that greater emphasis is placed on length of staple than on fiber diameter in commercial grading operations if it is done on a more or less uniform basis. The small percentage of fine staple and French fleeces in the Targhee breed is perhaps due to the large percentage of older ewes that are heavy lamb producers that have been retained in the flock. In general, the Targhee wool grades the most uniform of the three crossbred breeds.

It will be noted in the grading results for the Corriedale fleeces that 3/8 Blood is the predominating grade with a larger percentage of 1/2 Blood than 1/4 Blood.

The predominating grade for the Columbia fleeces was 3/8 Blood with slightly over twice the number grading 1/4 Blood than 1/2 Blood. There is a sprinkling of Low 1/4 Blood through the influence of a few old foundation ewes that carry considerable Lincoln influence in their breeding.

The 1943 clip was graded and is to be scoured by breed, grade, and sex.

1942 CLIP SCOURED BY GRADE

Reference is made to the clean yield table on page 29. The clean yield for the Targhee wool with the Bulk grading 1/2 Blood was 48.57%, which is an exceptional yield for this grade of wool produced under range conditions. The 1/2 Blood wool had approximately 4% higher yield than had the Fine wool. The commercial clean yield for 1942 was about 1½% greater than for 1941, as determined from commercially scoured bags of wool.

The Corriedale wool (Lot 8) had a clean yield of 49.13%, which is but slightly higher than that for the Targhee wool. This slight difference is rather difficult to explain unless it is due to the actual fine fiber diameter which has sufficient length to be graded as predominately 3/8 Blood for the majority of ewes in this breed. This may be a peculariety that prevails in the wool for this breed produced under range conditions such as prevail around Dubois, Idaho. It is more or less a known fact since fiber analysis work has been done on other Corriedale flocks that many of the fleeces actually measure finer than the official breed standard of 3/8 Blood wool (56's) for major portions of a fleece. The length meets the requirements for 3/8 Blood wool.

The Columbia wool graded predominately 3/8 Blood with about 1/3 of the wool from this breed grading 1/4 Blood. The 3/8 Blood (Lot 10, page 29) had a clean yield of 52% and the 1/4 Blood 57.4%. They were the highest yielding lots of wool scoured from any of the breeds involved for 1942.

The data on page 31 gives the 1942 grease and clean fleece weights based on commercial scouring results, grade of fleece and fleece values. A considerable range exists within and between breeds and between yearling and mature ewes for various grades of wool. These variations are readily detectable from the table.

CRUTCHING OF EWES

Refer to page 30.

SIGNIFICANCE OF CLEAN YIELD AND GRADE ON VALUE OF A FLEECE

Refer to pages 30 and 31.

STAPLE LENGTH--ITS INFLUENCE ON GREASE WEIGHT, SHRINKAGE AND FLEECE VALUES

Wool produced under range conditions by the Targhee yearling ewes for four years (1938-41), which was predominately 1/2 Blood wool, shows that for each $\frac{1}{2}$-inch increase in staple length there was an increase of 0.8 pound of grease wool, 0.5 pound increase in clean scoured wool, and a decrease of 2.5% in shrinkage. The shortest 5% of the fleeces measured 2.4 inches, or 1 inch shorter than the average of the entire group for the 4 years. The shorter fleeces measuring 2.4 inches which was 5% of the entire group had a grease weight of 9.7 pounds, which contained 3.3 pounds of clean wool, with a fleece value of $3.58. The average staple length for the entire group was 3.4 inches, with a grease fleece weight of 11.1 pounds, a clean fleece weight of 4.8 pounds, and a fleece value of $5.38. The longest group of fleeces (5% of entire group) measured 4.7 inches; they had an average of 12.6 pounds of grease wool, 6.2 pounds of clean wool, and a fleece value of $6.94. This shows a difference in fleece value of $3.36 between the longest and shortest fleeces from the Targhee breed. If 5% of the animals were culled this would eliminate the shortest fleeces and, in general, it would include the poorest mutton producers.

For each $\frac{1}{2}$-inch increase in the wool produced by the Corriedale yearling ewes, whose wool grades predominately 3/8 Blood, there was an average increase of .7 pounds of grease wool, .4 pounds of clean wool, and a decrease of 1.2% in shrinkage. The shortest 5% of the fleeces measured 3 inches, or 1 inch shorter than the average of the entire group and 2.4 inches shorter than the longest 5%. The shortest fleeces measuring 3 inches sheared 9.2 pounds of grease wool, yielded 4 pounds of clean wool, and had a fleece value of $4.04. The average for the entire group measured 4 inches and had a grease fleece weight of 10.6 pounds, a clean fleece weight of 5 pounds and a fleece value of $5.20. The longest 5% measured 5.4 inches and had a grease fleece weight of 12.2 pounds, a clean fleece weight of 6 pounds and a fleece value of $6.24. There was a difference of $2.40 in fleece value between the shortest and longest fleeces. Flock production could be increased by eliminating the shortest 5%.

The 3/8 and 1/4 Blood wool produced by the Columbia yearling ewes from 1938-1941 inclusive shows that for each $\frac{1}{2}$-inch increase in staple length the grease and clean fleece weight each increased $\frac{1}{2}$ pound. The shortest 5% of the fleeces measured 2.9 inches and had a grease fleece weight of 10.2 pounds, a clean fleece weight of 4.4 pounds, and a clean fleece value of $4.27. The average for the entire group measured 3.9 inches, with a grease fleece weight of 12.0 pounds, a clean fleece weight of 5.5 pounds and a clean fleece value of $5.50. The longest fleeces which constituted 5% of all the fleeces measured 5.4 inches long and had a grease fleece weight of 13.6 pounds, a clean fleece weight of 6.4 pounds, and a clean fleece value of $6.40. A difference of $2.13 existed in clean fleece value between the longest and shortest 5% of the fleeces. Here, again, by culling 5% of the shortest fleece producers from a breeding flock improved production would result.

In general, length of staple has more influence on amount of wool produced in the finer grades, and this influence decreases as the wool becomes coarser. Reference is made to page 32 for length influence on Rambouillet wool. (reference 28--Nat. Wool Grower, 33:6, June, 1943--pages 22-24).

## WOOL SAMPLING REGIONS IN 4 BREEDS OF SHEEP

A study was inaugurated to find the most accurate sampling regions in fleeces from four breeds of sheep producing different grades of wool and to study the relationship of the small sample clean-wool yield from the different regions to that of the whole fleece. Variation between small sample yield and whole-fleece yield was highly significant. Variations among regions was greater than among individuals within breeds. Lowest yields were obtained from the withers, back and rump, and the correlations and regressions involving the clean wool yield from these same regions and whole-fleece yield were likewise lower than the others. The difference in accuracy among the shoulder, side, back, hip or belly were so small that the choice could well be decided by whichever regions are easiest to sample. (Being prepared for publication).

## ESTIMATION OF CLEAN-FLEECE WEIGHT FROM GREASE-FLEECE WEIGHT AND STAPLE LENGTH

Refer to page 32 and reference 34.

## CLEAN YIELD AND FINENESS DETERMINATIONS IN ZONED AREA SAMPLES

Ten yearling Columbia ewe fleeces were random-selected for a fleece zoning study. One-half of each fleece was separated into small portions (zones) and the remaining one-half of the same fleece scoured intact. This study was initiated to secure basic information relative to the most representative area on the fleece from which to obtain samples for clean yield and fineness determinations. The analysis of these data has not been completed.

This study is being continued in 1943 with 10 head of Columbia yearling ewes. An identical study is being made of 10 Rambouillet yearling fleeces so that basic information will be available for the two most widely separated grades of wool produced at this station.

HAIRY BIRTH COAT IN LAMBS

Refer to page 34.